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A NOTE ON THE INORGANIC CONSTITUENTS OF NORMAL AND CATARACTOUS HUMAN CRYSTALLINE LENSES

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EFFORTS to devise some method of preventing the development of cataract in human lenses have long been pursued. Various recommendations have been made and practised, notably the application to the conjunctival surface of solutions or ointments containing soda, potash or calcium, iodine, dionine, etc., in different proportions and combinations. Electrical currents, optical contrivances, and internal medication have all had their advocates and practitioners. Faith healing has not been omitted. Quackery has flourished by such means, and unjustifiable pretensions and promises have emptied the purses of many timid and gullible patients hoping to escape from the prospect of extraction by surgical operation.

That the problem must be worked out on scientific lines is self-evident, and efforts in that direction have not been neglected, but so

far, with no very conclusive results. More precise knowledge of the conditions in which the lens is liable to lose its transparency, and the actual changes in its structure and chemical constitution are essential as a base from which to approach this problem. The investigation calls for the fullest possible knowledge of the nutrition of the normal lens, and of the possibility of modifying it by chemical or other treatment. One must enquire to what extent substances can be conveyed into the interior of the lens by absorption from the conjunctival sac, the aqueous or vitreous, or through the general circulation. Alternatively, is it possible beneficially to extract undesirable elements through the unbroken capsule of the living lens?

As a first step, it appeared to us desirable that a fresh series of observations should be made into the chemical condition of cataractous, as compared with transparent, human lenses, and that advantage should be taken of the most up-to-date methods of analysis. Very desirable also to employ for this purpose were lenses which had been extracted with intact capsules. The post-mortem room has supplied the transparent lenses; the hospital operating theatre the nontransparent group, kindly provided by colleagues who practise the intracapsular method of extraction.

Thus far, no attempt has been made by the writers of this paper to correlate the transparent lenses with the morbid condition of the cadaver from which the lens was taken.

Nor have the cataractous lenses obtained from living subjects been sufficiently numerous to classify them into special groups or varieties of cataract—only the sex and age of each patient have been noted, except in one group which was definitely known to have a traumatic origin.

The quantity of ash yielded by each lens is so small that the analysis has been carried out on groups of four lenses fortuitously placed together. It is hoped that larger supplies of lenses may make it possible and profitable to classify the lenses clinically. This, of course, can only be done through the co-operation of ophthalmic colleagues who are willing to take this extra trouble at the time of extraction and forward the clinical titles or comments along with the lenses when submitted for analysis. An appeal for such helpful team work is hereby made by the writers.

The present paper does not pretend to be more than a preliminary note intimating that this research is being conducted, and is launched in the hope of stimulating interest, support and encouragement.

Burge (1909) observed that human cataractous lenses contained much more calcium and much less potassium than did normal lenses, and this observation has been confirmed by Adams (1929). Burdon-Cooper and Lewis (1929) have obtained similar results, having shown by spectrographic analysis that the K/Ca ratio in the lens falls

with the development of cataract. The opacity of the cataractous lens has been ascribed to these changes in inorganic constituents, and especially to the increase in calcium. Thus, although Adams (1929) was unable to prove conclusively that increase in calcium content is the primary cause of the production of opacity, she found abnormal deposition of calcium in cataractous lenses, and her evidence was suggestive in other respects as well. The diminished potassium content of the cataractous lens has been made the basis of a method of treatment which has met with rather doubtful success, very similar results being obtained when sodium salts were applied instead of potassium salts. (Inglis Pollock, 1917-1923).

There are, however, other changes in the composition of the crystalline lens which has become cataractous, and although these may possibly be secondary to changes in the inorganic constituents, they indicate that alterations in the calcium and potassium are accompanied by changes in the concentration of other inorganic ions which may be equally important. Thus Lavagna (1926) has found cataractous lenses to have a lower pH than normal ones (*i.e.*, to be slightly less alkaline) a condition which would actually militate against the deposition of calcium phosphate, and to have a greater water content, as well as marked variations in the concentration of the organic constituents.

As a preliminary to further studies, we have for some time been engaged in the analysis of human lenses, normal and cataractous.

Experimental Methods and Results.—The cataractous lenses used in these analyses were removed with capsule, and placed at once in chemically clean, sterile, stoppered glass bottles, but not immersed in fluid other than the slight amount which might have adhered to them at the moment of extraction. It was not always possible to carry out the analysis at once—a number of the lenses were sent to us by post—so that it was impracticable to use the wet weight as a standard of comparison. In these circumstances we were compelled to use the dry weight* and the weight of ash. Neither of these, perhaps, is ideal, since Lavagna (1926) and others have found differences in the water content of normal and cataractous lenses. Burge (1909) too, reports a difference between the dry weight of the normal lens and that of the cataractous, but his figures are not particularly convincing, since one series of cataractous lenses (from the U.S.A.) had a smaller mean dry weight than his normal controls, while the other (from India) had a larger. Adams (1929), however, gives the average dry weight of 24 normal lenses as 53·0mg., and that of 31 cataractous lenses as 44.5mg.—probably an important difference though she states that she herself does not regard it as significant. Our own figures (Table I) show a definite diminution

* *i.e.*, the weight after drying at 105°C. until no further loss occurred.

in the dry weight of the cataractous lens. We find, in addition, that there is a tendency for the cataractous lens to contain rather less ash than the normal, but the two series overlap so completely that in spite of the difference in the mean values the figures cannot be regarded as more than suggestive. Although, on the average, a cataractous lens contains a slightly smaller weight of ash than the normal, transparent lens, the total weight of the cataractous lens is also smaller. So marked, indeed, is the diminution in size of the cataractous lens as a whole, that the ***percentage*** of ash in such a lens is actually greater than normal, whether the ash is expressed as percentage of dry weight or of wet weight (the latter being calculated from Adams' figures for the water content).

TABLE I.

Number of Lenses	Dry Weight in Mgs.		Weight of Ash Mgs.		Ash as percentage of *	
	Range	Average	Range	Average	Dry Weight	Wet Weight
Normal - - 18	53·7 to 67·5	60·14	1·10 to 2·22	1·59	2·64	1·04
Cataractous 27	30·0 to 50·6	44·07	1·10 to 2·40	1·41	3·20	1·44

* From Adams' (1929) figures :—

$$\frac{\text{Average Wet Weight}}{\text{Average Dry Weight}} = 2{\cdot}54 \text{ for normal; } 2{\cdot}21 \text{ for cataractous lenses.}$$

For analysis, the ash of four lenses (obtained by careful incineration in a platinum crucible at a temperature not exceeding 350°C.) was dissolved in a little dilute nitric acid, and the volume of solution was made up to 20 c.c. with distilled water. Aliquot portions of this solution were used for the various determinations. Potassium and calcium were determined by the methods of Kramer and Tisdall (1921*); sodium by the method of Kramer and Gittleman (1924); total sulphur by barium sulphate precipitation; total sulphate (on a separate series of single lenses) by the method of Denis and Leche (1925); phosphate by the method of Briggs (1924); and chloride by back titration with ammonium thiocyanate after addition of excess of silver nitrate.

The sulphate present in the ash includes part of the organic sulphur of the lens, as is shown by the fact that the method for

*Used also by Adams.

TABLE II.

Number and description of lenses	Dry Wt. Mg.	Ash Wt. Mg.	Calcium		Potassium		Sodium		Chlorine		Sulphur as SO_4		Phosphorus as PO_4	
			% Dry Wt.	% Ash	% Dry Wt.	% Ash	% Dry Wt.	% Ash	% Dry Wt.	% Ash	% Dry Wt.	% Ash	% Dry Wt.	% Ash
Normal														
4, male - -	215·5	5·8	0·026	0·98	0·705	26·2	0·412	15·3	0·056	2·1	1·13	42·2	0·495	18·4
4, male - -	243·0	6·8	0·034	1·23	0·696	24·9	0·316	12·3	0·095	3·4	—	—	0·655	23·4
4, male - -	270·1	7·0	0·031	1·19	0·487	18·8	0·189	7·3	0·150	5·8	1·28	49·4	0·511	19·7
4, male - -	235·6	8·4	0·024	0·64	6·654	17·3	0·623	16·5	0·087	2·3	—	—	0·487	12·9
Mean - -			0·029	1·01	0·635	21·8	0·385	12·6	0·097	3·4	1·20	45·8	0·537	18·6
Senile Cataract Mature														
4, female - -	144·3	5·5	0·210	5·51	0·114	3·0	—	—	0·469	12·3	1·82	47·9	0·320	8·4
4, female - -	197·8	4·5	0·118	5·25	0·025	1·1	0·622	27·3	0·084	3·7	1·24	54·4	0·355	15·6
4, male - -	199·3	7·6	0·159	4·18	0·107	2·8	—	—	0·351	9·2	—	—	0·343	9·0
4, male - -	116·8	5·3	0·318	7·01	0·122	2·7	—	—	0·395	8·7	1·92	41·9	0·526	11·6
Mean - -			0·201	5·49	0·092	2·4	0·622	27·3	0·325	8·5	1·66	48·1	0·386	11·1
Senile Cataract Immature														
4, male - -	202·5	7·4	0·084	2·31	0·309	8·45	0·603	16·5	0·272	7·4	—	—	0·303	8·3
Traumatic Cataract														
1, male - -	—	2·4	—	1·32	—	4·4	—	—	—	3·1	—	—	—	—

inorganic sulphate gives results definitely lower than those obtained by use of the method for total sulphate. Most probably, part of the phosphate is similarly combined organically in the lens as phosphoprotein or phospholipin, and though we have no direct evidence on this point, it is noteworthy that Lavagna (1926) found fully cataractous lenses to contain less phospholipin than normal ones—just as, in our series, is the case with total phosphate. Indeed, if Lavagna's figures be accepted, phospholipin appears to account for about three quarters of the total phosphate found in the lens.

The ash appears to contain practically no carbonate, a fact which is apparently to be explained by the replacement, during the process of ashing, of the carbonate (or bicarbonate) actually present in the lens, by phosphate or sulphate from organic compounds, the carbon dioxide, of course, being driven off. The ions actually estimated account for practically the whole of the ash, and indeed, in one or two cases they total to rather more than 100 per cent.—a result which is not altogether surprising in view of the difficulty of determining accurately such small amounts. It may be concluded, however, that other inorganic substances can only be present in relatively small amounts.

The results of analysis are summarized in Tables II and III.

TABLE III.

Sulphate content of lens.	SO_4 as % of dry weight.
Normal	0·549
Do.	0·561
Do.	0·494
Mean	0·535
Cataractous	0·567
Do.	0·661
Do.	0·671
Mean	0·633

Discussion.—Although it is somewhat unsafe to go very far in interpreting these results—in particular, further information is needed as to the forms in which the sulphate and phosphate of the lens exist, as well as on the presence of bicarbonate—two definite indications seem to emerge.

It is to be noted that the various inorganic constituents of the healthy lens are present in concentrations markedly different from those of the same substances in blood plasma, or—which is probably more important—in normal aqueous humour. The latter closely resembles cerebro-spinal fluid in composition, and thus does not differ very markedly from blood plasma. It contains rather more sodium than does plasma, about 5/4 as much chlorine, slightly less potassium, and about half as much calcium. Hence, to confine our attention to these substances, ignoring the phosphate and sulphate, of whose concentration in the lens we know little, we can contrast healthy lenses and normal plasma or aqueous humour as follows:—

Normal Lens.—

Potassium greatly in excess of sodium.

Calcium very low (about 10mg. per cent., calculated on wet weight).

Chlorine less than equivalent to sodium.

Aqueous Humour.—

Sodium greatly in excess of potassium.

Calcium about 5mg. per cent.

Chlorine about equivalent to sodium.

The lens is thus strongly differentiated from the aqueous humour and from blood plasma. (The vitreous humour has been ignored, since, apart from the improbability of its being concerned in the nutrition of the lens, little is known of its inorganic constituents. Its calcium content, however, is intermediate between that of the lens and that of the aqueous humour, *i.e.*, about 7·3mg. per cent., and its chlorine content is slightly below that of the humour (O'Brien and Salit, 1929.) In the cataractous lens, however, this power of maintaining its differentiation, at any rate from plasma, has been partly lost. Whether this also applies to the differentiation from aqueous humour must be a subject of future investigation. In the cataractous lens, sodium predominates over potassium, but the latter remains higher than in blood plasma, and the chloride is increased though it remains lower than in plasma. These changes are shown graphically in Fig. 1. There is thus a *tendency on the part of the lens to return to, or take on, a composition similar to that of blood plasma*, and this tendency is shown in immature as well as mature cataracts. It appears, indeed, to be progressive, and, therefore, to be closely connected with the diseased process.

A notable exception to this, however, is the calcium, which, instead of increasing slightly as would be expected in a general

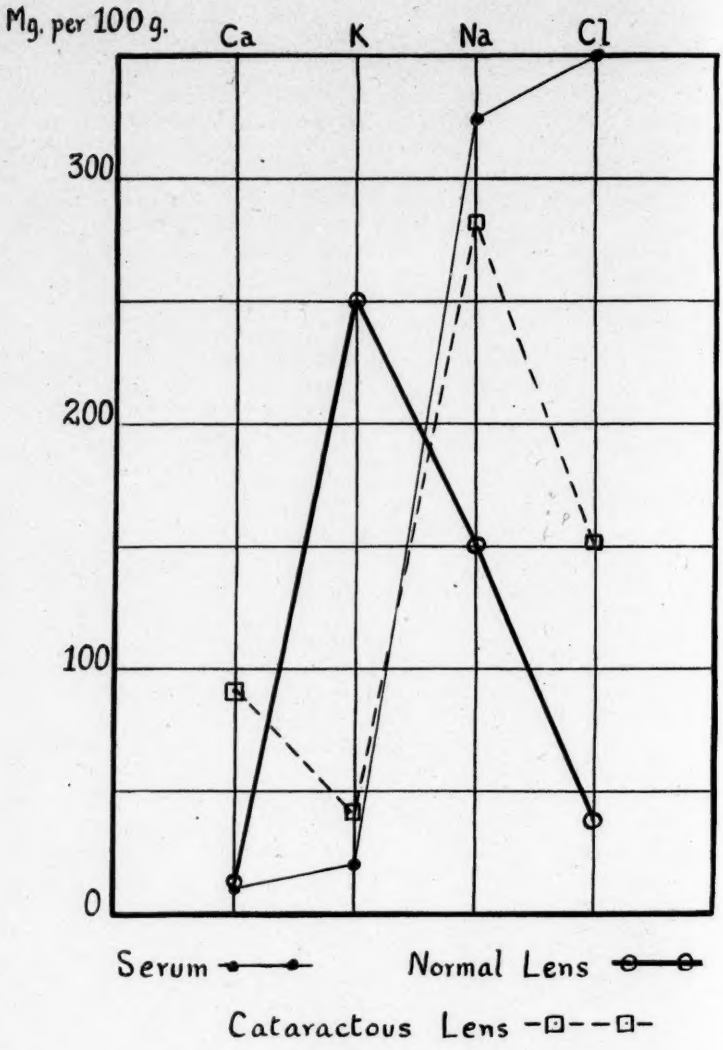

Fig. 1.

Comparison of some inorganic constituents of normal lenses, with those of cataractous lenses, and of serum. The figures for the lenses are calculated on the wet weight, using Adams' estimations of water content.

return to a plasma-like composition, is greatly increased in cataractous lenses, both absolutely, and relatively to the other ions. This argues some specific relationship of calcium to the development of cataract. Adams (1929), confirming the earlier work of Wessely (1922) and Kranz (1927), finds actual deposits of calcium (possibly as phosphate) in the cataractous lens, and relates the erratic occurence of these deposits with the wide variability in calcium content of individual lenses. Wessely and Kranz considered that the calcium deposition was secondary to a protein degeneration and Adams states that it cannot as yet be proved conclusively that the increase in calcium is a primary factor in the production of opacity in the lens. With this conclusion we must still rest content. The immature cataractous lenses show an increase in calcium content, which, however, is less than that in mature cataract, but they also show the other divergences from the normal, again to an intermediate extent. There is thus no evidence that calcium is the first constituent to alter, as one might expect if it were the primary factor. Yet undoubtedly the difference between the behaviour of calcium and that of the other inorganic ions during the development of cataract points to some special connection of the former with the production of opacity.

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"ANGINA CAPITIS"

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A HUNDRED consecutive cases of headache due to refractive errors were collected with the object of investigating the mechanism by which ocular headaches arise. Headaches caused by many other conditions of the body such as rheumatism are often found associated with a refractive error. In each of the 100 cases, however, the aetiological significance of the refractive error was established on the criterion that the headache was cured by the use of a correcting glass.

The commonly accepted mechanism of ocular headache is that it is a reflex pain due to the stimulation of the endings of the nasal branch of the ophthalmic division of the 5th cranial nerve being reflected along other divisions of this nerve. Thus changes in the eyeball are felt as pain in the region of the brow because the excitation is reflected so as to appear to come from the supra-orbital nerve; or as pain deep in the skull because the excitation is reflected so as to appear to come from the dural branches of the 5th cranial nerve.

A study of the facts, however, suggests a possible different mechanism.

The 100 cases divide themselves, according to the varying lengths of the eyeball, the varying curvatures of the corneal surface, and the senile condition of the accommodating mechanism, into (1) Hypermetropia, (2) Myopia, (3) Hypermetropic Astigmatism, (4) Myopic Astigmatism, and (5) Presbyopia. In these cases the part of the eye chiefly affected is the ciliary muscle. It is the main mechanism whereby the eye as a refracting medium can be so altered as to focus, or to endeavour to focus, on the retina incident corneal rays which otherwise, because of the refractive errors, would not be so focused. Abnormal use of the ciliary muscle must then be considered to be the stimulus for the reflex headache as it is the only condition in the eye which is common to all the headache-producing conditions mentioned above. The facts, first that this muscle consists of smooth unstriped muscle fibres, and secondly that the referred pain is in many cases, as will be shown later, felt outwith the skin distribution of the 5th cranial nerve, suggested to us that these headaches and faceaches are the result of a visceral reflex, with a mechanism similar to that which produces angina in cardiac disease, abdominal pain in diseased conditions of the intestine or the colic of a ureteric impaction.

The suggestion gains strength from the interesting and stimulating

ideas of Maitland Ramsay concerning the analogy which exists between the musculature of the ciliary body, the heart, and the intestinal tract.[1] He showed their anatomical and physiological similarity—hollow viscera bounded by unstriped muscle and innervated by the reciprocally interacting sympathetic and autonomic systems. He showed the similarity in the actions of such drugs as cocaine and atropine on these organs, and made a strong analogy between such diseases as heart block and the Argyll Robertson pupillary reactions.

Perhaps the best way to prove this contention will be: first to consider in detail what is already known of referred visceral pain, and then, secondly, to show how the conditions found in ocular headaches coincide anatomically, physiologically, clinically, and experimentally with the accepted facts of referred visceral pain.

(1) *The Mechanism of Referred Visceral Pain.*—James Ross in 1888 called attention to the fact that the pain in visceral disease was often felt at a distance from the organ which caused it and described the pain as "referred."[2] He drew attention to the fact that the sympathetic nerve, which supplied the affected organ arose from the same part of the spinal cord as did the nerve supplying the area of skin in which the pain was felt.

Head said that the mechanism of the pain was as follows:—excitations arising from the stimulation of the sympathetic nerve endings in the viscus are carried through the sensory root posterior to the ganglion into the cord.[3] In the cord the sympathetic fibres come into contact with the fibres of the sensory somatic system and so incite them to reaction that the brain perceives the original visceral stimulation as coming from the peripheral distribution of the somatic nerve involved.

A study of the anatomy and physiology of the eye shows that it possesses the necessary machinery whereby the somatic sensory and the sympathetic afferent and efferent nerve fibres can interact in the manner required for the establishment of a reflex visceral mechanism as postulated by Head[3] and Mackenzie.[4] The eye may be considered as a hollow organ with a portion of its area covered by unstriped muscle fibres—the ciliary muscle. Its autonomic efferent nerves are supplied from the mid-brain *via* the 3rd nerve and the motor root to the ciliary ganglion. These fibres carry stimuli for contraction of the ciliary muscle and the sphincter pupillae. Whether they contain inhibitory fibres or not has been debated, but Poirier says that the sensory root of the ciliary ganglion contains sympathetic fibres which relax the ciliary muscle and others which dilate the pupil.[5] Whitnall, however, denies that it has been shown that the sympathetic can produce a negative accommodation.[6]

The pupillo-dilator fibres are considered to arise from a supposed centre in the mid-brain near the origin of the constrictor tract in

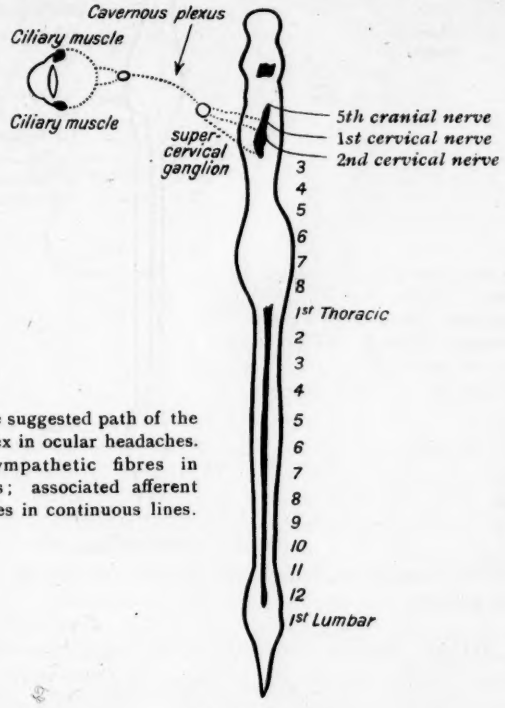
the fore part of the 3rd nerve nucleus. They pass down through the medulla into the lateral columns of the spinal cord, from which the preganglionic fibres pass out by the anterior roots of the 1st, 2nd and 3rd thoracic nerves to run in the cervical sympathetic up to the superior cervical ganglion where they terminate. Their further course is problematical. They reach the dilatator muscle either *via* the cavernous plexus and the sympathetic root of the ciliary ganglion or else *via* the Gasserian ganglion and the long ciliary nerve of the nasal branch of the ophthalmic nerve. The afferent sympathetic fibres from the eye pass out from the ciliary ganglion either by its sympathetic or else its sensory root which conducts them to the Gasserian ganglion. Their precise course is unknown but in all probability they pass to the superior cervical ganglion. This ganglion by means of four grey rami-communicantes is associated with the upper four cervical nerves.

The somatic sensory nerve supply for the eye and the greater part of the face and head is the 5th cranial nerve. Its three divisions supply the eye and the face with sensation. Its root ganglion is the Gasserian ganglion which may thus be considered as the fused posterior ganglia of those somatic afferent nerves which correspond with all the motor nerves originating in the brain stem. The trigeminal system contains three main nuclei: the mesencephalic, the bulbo-spinal, and the motor. On entering the pons the afferent fibres divide into ascending and descending courses. The ascending fibres pass to the mesencephalic root, close to the grey matter surrounding the aqueduct of Sylvius. The descending fibres run as far as the level of the second cervical vertebra where they establish relationship with cells close to the substantia gelatinosa of Rolando. The exact nature of the mesencephalic root has not yet been definitely elucidated, but the generally accepted view is that it subserves the proprio-ceptive sense of the mandibular muscles (Kappers, Kidd, Parsons).

The bulbo-spinal root is sensory and somatic. Its lowest portion, called by Winkler the nucleus gelatinosus, extends as far as the level of the second cervical vertebra and is concerned with exteroceptive impulses. From below upwards the nucleus gelatinosus receives fibres from the ophthalmic, the maxillary and the mandibulbar divisions of the 5th nerve, thereby retaining the early metameric arrangement of the somatic afferent nerves. We have thus the necessary anatomical framework whereby sympathetic afferent nerve impulses from the ciliary muscle can form a cord relationship with the 5th cranial and 1st, 2nd and 3rd cervical nerves and thereby with extensive skin areas of the head and neck. Moreover from *a priori* considerations it can be postulated that the referred pain will be felt in those skin areas which are supplied by the upper cervical nerves and the lowest part of the

nucleus gelatinosus, that is the ophthalmic division of the 5th cranial nerve (Diagram A).

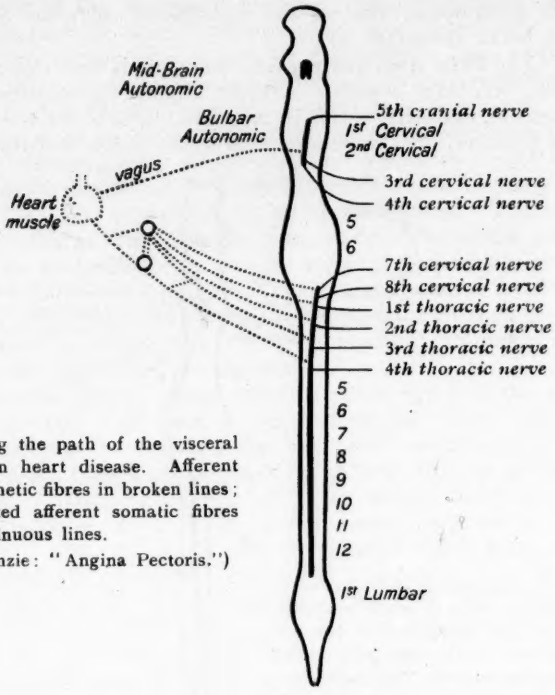
(2) *The Skin Area Involved.*—The pain is felt superficially in the skin, voluntary muscles or loose underlying connective tissue (Mackenzie), and each viscus is associated with a definite skin area which, however, does not correspond to the entire distribution of a



Showing the suggested path of the visceral reflex in ocular headaches. Afferent sympathetic fibres in broken lines; associated afferent somatic fibres in continuous lines.

DIAGRAM A.

particular nerve but rather to the cord segment with which the viscus has sympathetic connection (Mackenzie). These areas are most likely the zone areas of Head. Thus in cardiac disease we often have pain (angina) in the left side of the chest, left arm and sometimes along the jaw and behind the ear at the back of the head. This is explained in the former cases by the assumption that afferent sympathetic impulses pass from the heart to the cord at the level of the last cervical and the first thoracic segments and in the latter cases by means of the vagus nerve and its roots to the level of the upper cervical segments where the 2nd and 3rd cervical nerves are more particularly involved.[4] On considering the



Showing the path of the visceral reflex in heart disease. Afferent sympathetic fibres in broken lines; associated afferent somatic fibres in continuous lines.
(Mackenzie: "Angina Pectoris.")

DIAGRAM B.

100 collected cases we found the analysis of the pain distribution to be as follows:

WITHIN THE DISTRIBUTION OF THE 5TH CRANIAL NERVE.

Eyes.	Lower Frontal.	Temple.	Upper Frontal.	Mid-Frontal and Root of Nose.	Cheek.	Side of Nose.
16%	40%	7%	29%	7%	1%	1%

OUTWITH THE DISTRIBUTION OF THE 5TH CRANIAL NERVE.

Occiput.	Nape of Neck.	Vertex.	Mastoid.
15%	3%	6%	2%

26%

It is to be noted that several of the patients located the pain in two distinct areas, as for example in the brow and in the occiput.

The analysis shows that those areas are affected which anticipation demands to be affected if the mechanism be that of referred visceral pain. The skin areas mainly affected are those supplied by the ophthalmic division of the 5th cranial nerve and the 1st,

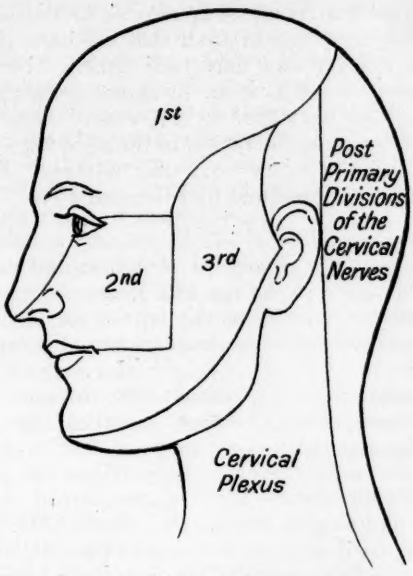


DIAGRAM C.

2nd and 3rd cervical nerves. In 26 per cent. of the cases the pain was felt outside the distribution of the 5th cranial nerve. Can this extra-ophthalmic distribution be explained on the basis of a purely somatic reflex whose afferent path is the ophthalmic division of the 5th cranial nerve? To our mind this incidence is difficult to explain in any way other than by the mechanism postulated above.

(3) ***Nature of the Stimulus.***—The nature of the stimulus whereby the afferent sympathetic fibres can be excited has been the subject of much discussion. There is no general agreement. Cannon and Washburn believed contraction of the visceral muscle to be the necessary stimulus.[7] Mackenzie suggested that vigorous peristalsis is the stimulus. Sherrington said that mechanical stimuli to be sufficient must be distensile.[8]

Hurst combined the above theories.[9] He suggested that a down-wave of peristalsis produces a ballooning of the viscus just beyond the contraction and that the pain-inciting stimulus is that ballooning of the muscle. Poulton experimenting with the oesophageal bag showed that the effective stimulus was distensile and produced by the stretching and consequent deformity of the nerve endings subserving the sense of pain which are situated in the wall of the viscus.[10] He showed that a peristaltic contraction may relieve pain and that on the other hand pain may be felt during a relaxation of the contraction.

There is thus great diversity of opinion as to the precise visceral condition which is necessary in order that stimulation of the nerve-endings in the visceral wall may take place. At one end of the proposed explanations we have an increased muscular contraction and at the other end the distensile theories of Sherrington, Hurst and Poulton. It is not unlikely that in the same organ the adequate reflex inciting condition varies from time to time. The tension of a cylindrical body is represented by the equation:—

$$T = pr$$

where p is the pressure inside the structure and r is its radius. Therefore any variation in the size of a viscus (r) may or may not cause a corresponding change in the tension of its wall according to whether the pressure of its contents rises or falls with the changed visceral posture.

It is possible that another pertinent circumstance is the precise position of the sympathetic afferent nerve endings. If they are outwith the muscular layer, contraction of that muscle will relieve the tension on the nerve endings, and so relieve the pain (Poulton). If they are within the muscle layer contraction of the muscle will stimulate them and so give rise to pain (Mackenzie).

We have thus tried to group the various visceral conditions which may suffice to stimulate the pain nerve-endings. We believe that they can be shown to exist in those eyes which produce headache because of hypermetropia, myopia, astigmatism or presbyopia. The following table shows the relative frequency of these conditions as found in the 100 collected cases:

	Per cent.
Hypermetropia	5
Myopia	13
Hypermetropic astigmatism	47
Myopic astigmatism	22
Presbyopia	13

In compound astigmatism the case was considered to be one of simple astigmatism unless the hypermetropia or myopia played the obviously preponderating rôle. Let us consider the visceral condition in each of these divisions.

In *hypermetropia* there is an increased contraction of the ciliary muscle in order to overcome the shortened condition of the eyeball. Increased contraction of smooth muscle is one of the accepted stimuli in the production of visceral pain.

In *myopia* the nature of the stimulation is more difficult of explanation. We have here an inhibition of the ciliary contraction which usually accompanies convergence. It is possible that the effective stimulus is Poulton's "increase of posture" resulting from the ciliary relaxation. Or is it possible that the upset of the normal

muscular co-ordination is in itself a sufficient stimulus? It is difficult to say why one case of myopia should suffer from headache and another not do so. Other things being equal it may depend on the accidental anatomical position of the sympathetic afferent nerve-endings as suggested above. If these nerve-endings are within the muscle layer, relaxation of the muscle might be expected to relieve the tension on them. While if they are without the ciliary muscle layer, a myopic relaxation will have a contrary effect and so give rise to a headache.

In *astigmatism* we hoped to find a stimulus for the headache which was more specific for the astigmatic cases than those detailed above under hypermetropia and myopia. With this end in view we made an analysis of the frequency of the different kinds of astigmatism found in the cases under discussion, and we made a study of the literature with regard to the nature of the contraction of the ciliary muscle. The frequency of the different kinds of astigmatism in the collected cases is tabulated below:

	Hypermetropic astigmatism. Per cent.	Myopic astigmatism. Per cent.
Direct astigmatism	54 ...	50
Indirect astigmatism	18 ...	15
Symmetrical axes	41 ...	50
Homologous axes	16 ...	None
Non-related axes	43 ...	50

Cases were considered to have an axis of 90° and 180° if they were within 15° of those axes.

A similar latitude was taken in differentiating axes into symmetrical and homologous types.

In a consideration of 4,000 unpicked cases of astigmatism Lang found 38 per cent. cases of direct astigmatism and 24 per cent. cases of indirect astigmatism.[11] We thus found in our cases no abnormal prevalence of any particular variety of astigmatism. Our findings do not confirm the generally accepted view that indirect astigmatism is more prone to headache-production than direct astigmatism. Moreover in a study of the literature we found that nothing is known of a path of nervous conduction or a wave of muscular contraction in the ciliary muscle. Nor has a partial contraction of the ciliary muscle been shown to take place.[12] With these negative findings in mind we cannot at present postulate any stimulus for the visceral reflex which would be more specific to these cases of astigmatic headache than those suggested above for simple hypermetropic and myopic headaches. Astigmatism is, however, by far the commonest cause of ocular headaches, and it is probable that another, secondary, non-muscular factor is brought into play. No action of the ciliary muscle can prevent the image

cast on the retina of an astigmatic eye from being blurred, and it is possible that the visceral reflex is facilitated by the consequent disturbance in consciousness. It is a well-known fact that slight psychical disturbances can provoke an attack of angina pectoris.

In ***presbyopia*** there is an attempt at accommodation by contraction of the ciliary muscle. If the physiological theory of presbyopia as suggested by Donders and supported by Duane be correct, the maximal ciliary contraction serves as an ideal stimulus for the excitation of the visceral reflex.

In analysing the visceral condition in these cases of hypermetropia, myopia, astigmatism, and presbyopia we have laid stress on the condition of the ciliary muscle, and have made no mention of the internal pressure of the eye-ball. Our considerations above suggest that this is as causally important as the condition of the ciliary muscle and we hope in a further report to study the association between ametropia, intra-ocular tension, and the reflex headache.

(4) ***The Effect of Fatigue.***—Mackenzie has emphasized the causal importance of the accumulation of fatigue products in cases of angina pectoris. He suggested that this condition obtains when:

1. The muscle is repeatedly contracted.
2. The muscle is insufficiently supplied with blood because of capillary changes or because of the morning ischaemia following sleep.

In order to establish the importance of repeated muscular contraction we made an analysis of the time and work incidence of the headache in each of the 100 cases under consideration. It was as follows:—

Headache produced by near work, 55 per cent. of cases } 81
Headache worse in the evening, 26 per cent. of cases } per cent.

The 26 per cent. of cases who experienced the headache in the evening were among the 45 per cent. who did not confess to the headache being produced by near work.

Thus in a great many cases increased muscular activity and fatigue were necessary before the headache was felt. Muscle fatigue is then an important contributory factor just as Mackenzie has shown it to be in the production of angina pectoris.

Again in 23 per cent. of the cases under consideration the headache was felt on rising in the morning. In these cases we may suppose that the ciliary muscle was insufficiently supplied with blood because of the morning ischaemia following sleep. We have thus present in those eyes, yet another muscle condition, which in other parts of the body, can serve to waken the visceral reflex.

(5) ***The Nature of the Referred Pain.***—The nature of the referred pain differs from other pains in that it is usually of a wave-like character, beginning gradually, reaching a maximum and then subsiding (Mackenzie). Moreover it leaves a vague impression of

locality, being regional rather than local (Mackenzie). Although in certain circumstances the viscus may be the seat of a "low" form of protopathic sensation, acute pain felt in it is usually the result of the stimulation of somatically supplied adjacent tissues, for example the sub-peritoneal tissue, the pleura, or the pericardium.

Each of the 100 cases under consideration was asked the nature of the pain; it was variously described as follows:

	Per cent.
Dull, aching throb	43
Sharp, knife-like pain	24
Heavy, tired feeling	10
Tight, gripping feeling	8

(Chiefly in the occipital headaches occurring with hypermetropic astigmatism.)

It will thus be seen that the majority suffered from the typical wave-like, stunning pain of muscular origin. Nearly all the patients showed reluctance or difficulty in "placing" the pain. They nearly all said it was "about the head" and only on enquiry could it be localized to a definite area of the head. In the reflex pain of tooth-ache or glosso-pharyngeal neuralgia where the nerve-implication is purely somatic there is not the same difficulty in locating the pain. 16 per cent. of the cases complained of pain in the eye. In nearly all cases the pain was a "dull ache," corresponding to the "low" form of direct protopathic sensation found in the viscera generally, and unlike the more acute pain experienced in iritis or during an iridectomy. The somatically supplied iris and ciliary body may be considered to bear a relationship to the ciliary muscle analogous to that which exists between the peritoneum and intestine, the lung and the pleura, or the pericardium and the heart.

(6) ***Relationship between Hyperaesthesia and the Pain.***—Segmental hyperaesthesia is often found in the abdomen during an attack of ureteric colic. Mackenzie showed its frequency in angina over those areas where the pain was felt. He also demonstrated that the hyperaesthesia often outlasts the pain, making the inference that the nerves remained in a state of hyperexcitability.

Owing to the exigencies of an out-patient department the state of the skin was not tested in all the cases. Hyperaesthesia was looked for in 55 cases about the distribution of the supra-orbital nerves. It was found in 15 cases all but one of which were unilateral. In six of these cases the hyperaesthesia disappeared with the headache.

Tenderness on deep pressure over the supra-orbital foramina was also tested for in these 55 cases. It was found in 20 cases, four of which were bilateral. Ten of these cases showed no deep tenderness after the headache had gone.

We thus found hyperaesthesia of the skin in a fair proportion of cases, which in only 50 per cent. of these cases had disappeared several weeks after the cure of the headache.

(7) *Effect of the Reflex on Voluntary Muscle.*—Transmission of the stimulus to the cord also affects the adjacent muscle centres, thus causing a tonic muscular contraction in the area supplied by the efferent somatic nerve. This is seen typically in the abdominal rigidity of appendicitis and in the retracted testicle of renal calculus. Mackenzie has pointed out that this viscero-motor reflex may be present although the viscero-sensory reflex be absent.

The statistics were not made with respect to the accompanying viscero-motor reflex in the collected cases. It is a well-known fact, however, that the corrugator supercilii and the frontalis muscle are often tonically contracted in subjects suffering from ciliary headaches. This viscero-motor reflex, moreover, is often observed in cases of ametropia even although no headache is complained of. These motor reflexes demand an association between the afferent impulses from the eye and the 7th cranial nerve nucleus. This contraction of the corrugator supercilii is thus comparable with the contraction of the cremasteric muscle in renal colic and the rectus abdominis in appendicitis.

(8) *Effect of the Visceral Reflex on Other Reflexes.*—In some cases the visceral lesion may produce an irritable focus in the cord so that stimuli coming to this level of the cord would be perceived as pain. For example liver disease is sometimes associated with the painful entrance of food into the stomach (Mackenzie).

In "ciliary headache" this effect is seen in the tachycardia, flatulent and other types of dyspepsia which occasionally accompany it. The afferent sympathetic stimuli from the ciliary muscle may be considered to produce an irritable focus in the cord whereby the vagal and sympathetic nerve supply to the stomach and heart are reacted upon. In this connection it is interesting to quote that in the opinion of Behan "all the thoracic and abdominal viscera which refer pain into the dorsal area of the scalp are supplied by the vagus and glosso-pharyngeal nerves which represent the visceral branches of a set of nerves whose somatic sensory root is to be found in the sensory portion of the 5th cranial nerve."[13] Again the considered opinion of Maitland Ramsay may be noted. "Neurasthenia makes the use of glasses imperative if any error of refraction exists and in such cases the use of glasses is a valuable therapeutic measure because the cure of the patient is aided by removal of one cause of irritation to the nervous system."[1]

(9) *Effect of the Condition of the Nervous System on the Visceral Reflex.*—The degree of pain in a visceral reflex depends on the changing nervous excitability of the nervous system. The hyperexcitability may be local or general. In the former case it is due to a particular level of the cord being sensitized by afferent stimuli. In the latter case the central nervous system is rendered more sensitive by such general conditions as

(*a*) Toxic conditions.
(*b*) Overwork or lack of sleep.
(*c*) Mental worries.
(*d*) Sex disturbances.

The result is that impulses, which in normal healthy conditions would produce no recognizable effect, give rise to demonstrable results such as reflex pain. This state of affairs is seen typically in secondary angina.

In each of the 100 collected cases some inquiry was made into the existence of these general sensitizing conditions. It was not possible in the circumstances to make any thorough investigation regarding the co-incidence of the headache with constipation or other toxic conditions. Most of the patients said that otherwise they were in very good health. Only six confessed to some systemic disturbance. In four cases the headache commenced after taking food. It is a well-known fact, however, that a patient convalescing from an illness may complain of ocular headache which requires the use of temporary glasses, although in health the refractive error or the presbyopia may have been unsuspected or absent. The general debility probably produces a too early ciliary exhaustion as well as a too sensitive nervous system. In this connection may be mentioned the frequency with which lactating mothers suffer from temporary ciliary headache.

Similarly it was not feasible to enquire into the sex history of the patients. The sex and age incidence of the cases was as follows:—

Male 36 per cent. Average age 28 years.
Female 64 per cent. Average age 28 years.

Below are separately graphed the age incidence curves among the males (- - -) and females (—)of the collected cases:

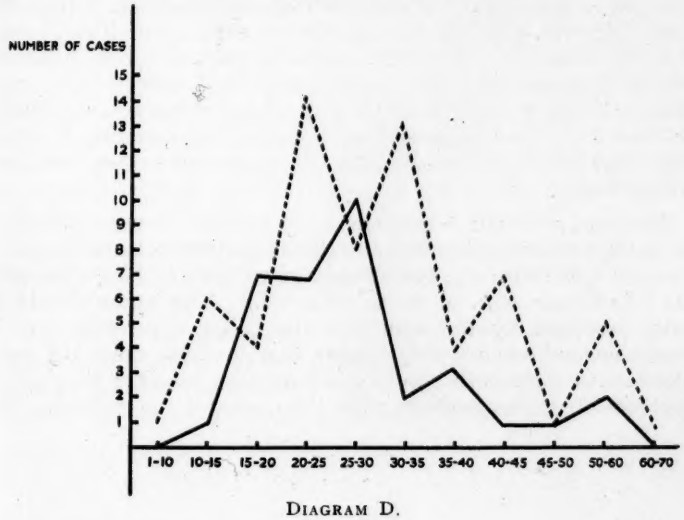


DIAGRAM D.

Most of the cases occurred in the third and fourth decades of life. It is interesting to note in the female a rapid rise of the curve in the 10-15 years period, which in the male is delayed until the 15-20 years period, and likewise the difference between both curves during the 40-45 years period.

Only seven cases were outside the active sex period. In each of the female cases a note was made regarding the relationship of the headache to menstruation. Fifteen of these cases, *i.e.*, 25 per cent., showed a menstrual incidence of the headache, usually two or three days prior to the onset. Occasionally the headache persisted during the flow. Such a fact is rather important therapeutically because headaches occurring about these times are usually relegated into the category of "menstrual headache" and treated from the wrong standpoint. We were told of a patient with a diseased ovary which invariably gave rise, on being palpated *per vaginam* to a severe ipso-lateral parietal headache. In this case the afferent visceral stimuli from the ovary after reaching the cord affected the cervical region presumably by association. In general, however, the sex association is causally important in that it increases the excitability of the central nervous system and so permits otherwise innocuous afferent ciliary stimuli to produce their reflex.

(10) *Effect of Age on Referred Visceral Pain.*—It has been observed in angina pectoris that advancing years often diminish the frequency of the pain. Elderly people have an earlier sensation of tiredness which inhibits the muscular activity from reaching that pitch which would act as a sufficient stimulus for the pain reflex.

In correcting elderly astigmatics it is not unusual to be told that although now quite free from pain they once suffered severely from what we can reasonably conclude from their descriptions to have been ciliary headache. In the 100 collected cases apart from the presbyopic ones, only four patients were over the age of 40. It must be noted, however, that numbered among the presbyopic cases are several hypermetropes and astigmatics who were able to read Jaeger 1 without an addition to their distance correction. These have been described as presbyopes because their inability to overcome their ametropia is essentially due to the presbyopic condition of their lenses.

Moreover, although presbyopic cases formed 21 per cent. of all the cases coming for spectacles to the out-patient department of the Glasgow Eye Infirmary, the number of presbyopic headache cases was only 13 per cent. of those collected.[14] The reflex should be easily provoked by the nature of the ciliary contraction in the presbyope, and one can only assume that in these cases the same process is at work as that to which Mackenzie ascribed the lapsing incidence of angina pectoris with the ageing of the patient. The

presbyope does not have headaches as often as he might because he readily feels the sensation of ciliary tiredness and so by ocular rest prevents the ciliary muscle from reaching that condition which would act as a sufficient stimulus for the production of the viscero-sensory reflex.

(11) *The Reversibility of the Viscus-Skin Reflex.*—The relationship between the skin sensation and the visceral activity is a reversible one. That is to say that a stimulus applied to a skin area produces changes in the corresponding viscus. This is the principle underlying the use of counter-irritation which has for long been employed for the relief of visceral disease. The counter-irritant in virtue of the fact that it relieves visceral pain might be expected to do so either by removing, or by producing, the converse of that visceral condition which excited the reflex. Thus Poulton experimenting with the oesophageal bag showed that friction over the sternum relieved oesophageal pain by means of an "increase of posture" accompanied by a fall of pressure, or by a contraction of the smooth oesophageal muscles whereby the strain on the nerve-endings was relieved.

This postulate of reversibility is remarkably seen in the dilatation of the pupil which follows stimulation of the skin. Head has shown that dilatation of the pupil follows pinching of the hyperalgesic areas and that it is more marked ipso-laterally. He also showed that if areas other than the hyperalgesic zones be pinched, the stimulation must be more severe in order to produce the same dilating reflex. This reaction presupposes an association between the somatic nerve supply, particularly of the hyperalgesic zones, and the efferent sympathetic nerve supply of the eye, which probably because of the wide latitude of the skin area involved takes place in the spinal cord. Moreover this visceral effect of the skin-pupil reflex is the more significant when it is appreciated that besides the stimulation of the dilatator pupillae there is an inhibition of the sphincter pupillae (Whitnall) and in all likelihood a corresponding inhibition of the ciliary muscle. Clinically this beneficent skin-eye reflex is made use of by the application of poultices and blisters to the brow and temples for such conditions as iritis and cyclitis where it is considered advisable to dilate the pupil and relax the ciliary muscle.

Experimentally the following method was used to show that a relaxation of the ciliary muscle takes place when the skin of the brow is stimulated.

A series of nine consecutive cases of hypermetropia was taken in each of which there was a fair degree of latent hypermetropia. A mustard-leaf was applied to the forehead in each case for 10-12 minutes and the subjective test repeated. The differences between

the latent hypermetropias before and after the application of the counter-irritant is tabulated below:—

CASE.	Differences in dioptres of latent hyper. before and after counter-irritation.
1	+1·50
2	0·75
3	0·50
4	0·25
5	0·75
6	0·75
7	0·50
8	Nothing
9	0·50
Average	0·60

We see thus that on an average 0·60 dioptres of relaxation was obtained in the ciliary muscle as the result of the application of an irritant to the brow. This seems to establish the reversibility of the relationship between the ciliary muscle and the skin and thereby to fulfil one of the postulates which our presumption of a viscero-sensory mechanism demands. Moreover it is comparable to the "increase of oesophageal posture" which Poulton demonstrated to be a consequence of friction applied over the sternum.

Summary

(1) A resumé has been made of the chief known facts of referred visceral pain, physiological, clinical and experimental.

(2) A study has been made of the activity and innervation of the ciliary muscle, of the clinical features of ocular headache, and of an experimental relationship between the skin and the ciliary muscle.

Conclusion

There has been shown a sufficient concurrence between both sets of facts to justify the suggestion that the mechanism which underlies ciliary headache is analogous to that which gives rise to referred visceral pain in other parts of the body. More particularly that ciliary headache arises from ciliary dysfunction in the same way as angina pectoris arises from cardiac dysfunction. The work for this communication was carried out at the Glasgow Eye Infirmary in the unit of Dr. J. Barbour Stewart. I wish to thank him and Dr. A. J. Ballantyne for their kind assistance and advice.

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SCHOOL MYOPIA*

BY

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THE problem of school myopia is the problem of the development of myopia. This is a truism which needs stressing in these days when the conception of myopia as a physiological variation in a scale of refractive errors is becoming more established. If it was a fallacy to regard myopia as something distinct from other refractive conditions, it is equally fallacious to regard it purely as the antithesis of hypermetropia, in a graduated series in which refraction approaching emmetropia is the peak and centre.

Though it raises more problems than it solves, the work of Steiger and his school is undoubtedly the most important contribution to myopia that has been made during the present century. By pointing out that hypermetropia cannot be divorced from myopia, that emmetropia is an artificial conception, and myopia a continuation in an unbroken process, the whole of which can be represented by a curve corresponding to a theoretically derived

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binomial curve, Steiger has emphasized the unity of the different spherical refractive conditions, and shown that at least some myopes must be regarded as normal variations occurring in any large group of people. In such view, long and short eyes get the same significance as tall and short individuals, *i.e.*, they are variations around a common mean, the frequency declining progressively the more marked the variation.

It is, of course, true that all myopia cannot be thus explained. For, even the few curves available at present which deal with large numbers prove conclusively that the myopic side of such a curve shows lengthening, thus destroying the symmetry of the binomial curve. *Scheerer and Betsch* have, however, shown that if all cases which show myopic crescents and other fundus changes are excluded from such a curve, then its simple binomial nature again becomes apparent (Figs. 1 and 2). A similar result is obtained if all cases over *−6.0 D. are excluded (Tron).* Arguing from such analyses a physiological and a pathological type of myopia have been suggested, the one being a normal variant in a large series, and differing in no essential way from its opposite on the hypermetropic side of the curve, and the other being a distinct aberration, determined by pathology, heredity or some other factor.

Another deviation from a calculated curve is shown by the curves established by Scheerer and Betsch for 12,000 eyes, and by Brown and Kronfeld for 5,000 eyes, for which it appears that emmetropic cases are in excess of their theoretical value (Fig. 1). The steep excursion could be criticized in the first series on the ground that

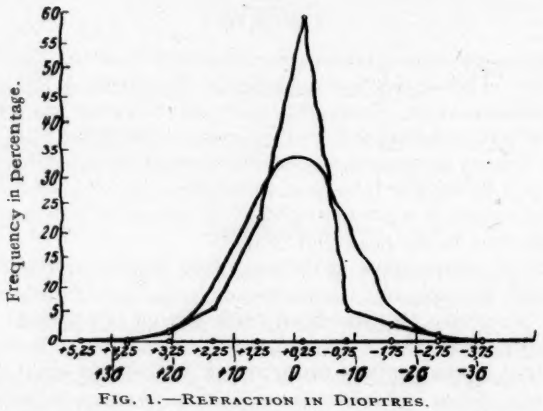

FIG. 1.—REFRACTION IN DIOPTRES.

Comparison of the combined refraction curve of Scheerer and Betsch, with the theoretically derived binomial variation curve. (After *Franceschetti, Kurzes Handbuch* der Ophthalmologie, Bd. 1, S. 720).

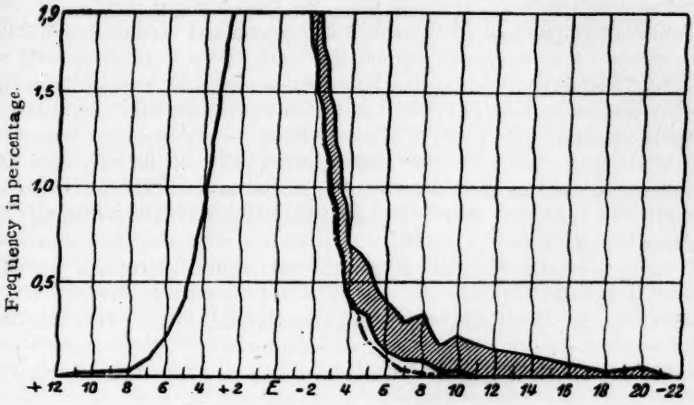

FIG. 2.—REFRACTION IN DIOPTRES.

Frequency curve of refraction (after Scheerer) (Magnified base of the frequency curve shown in Fig. 1). The shaded area covers the cases of myopia with fundus changes. The broken line, ·—·—· is the theoretically symmetrical curve on the myopic side.

the refractions were done without cycloplegia. In the second series, this objection does not hold. A process of "emmetropization" (Straub) has been called in to explain this anomaly, this process acting by a correlation of the different components of the total refraction (cornea, lens, axial length, etc.) to produce emmetropia, natural selection helping in that direction (Steiger).

It is clear that Steiger's hypothesis in an unmodified form, though it throws a flood of light on the problem of refraction, does not in itself explain all the refraction anomalies. But that there is some underlying unity which this theory stresses is strongly supported by the recent work of Tron, Vogt and others who have thrown grave doubts upon the old accepted view that myopia is essentially an increase of axial length and that the fundus changes associated with myopia are due to stretching of the posterior pole of the globe.

Tron has analysed 53 emmetropic eyes into their different refractive components, and has shown that not only is there no fixed corneal refraction for emmetropia, but that also the other factors show great variation. Thus, the total refractive power of the eye, that of the lens, of the cornea, and the axial length, all show definite excursion around a mean which is the apex of a binomial curve.

Refraction of cornea	...	37·00 – 48·14 D.
Refraction of lens ...	...	20·19 – 34·09 D.
Refraction of eye ...	...	57·47 – 72·10 D.
Axial length ...	...	20·46 – 25·46 mm.

From these data it appears that the mean axial length of the emmetropic eye is 22·74 mm., but as the normal variation is ±3·72, an emmetropic eye may be as short as 19·02 mm. or as long as 26·46. Similarly, taking into account the normal variations in the different components of total refraction, it is possible to have a highly myopic eye actually shorter than an emmetropic or even hypermetropic eye. As Tron shows: an eye of +4·0 D. may have the same axial length as one of −6·0 D.; likewise +6·0 D. and −9·0 D. may result from the same axial length. It has been customary to ignore the variations in the lens in correlating axial length and corneal refraction, but the normal extremes of refraction between 20—34 D. show that this cannot be done. With these great excursions in the normal value of cornea, lens, axial length and total refraction, the notion that low myopia is due to elongation of the axis must be reconsidered, especially in that large class of low myopes who show no fundus changes at all. Tron shows that there is a positive correlation of medium magnitude between myopia and axial length. But this only proves that myopic eyes have more frequently long axes than hypermetropic eyes.

It is, therefore, not possible to draw any clear line of demarcation between myopia and hypermetropia, for a combination of normal variants can give emmetropia or a marked refractive error in either direction. When, in addition, doubt is thrown upon the so-called myopic fundus changes being due to stretching (Schnabel and Herrnheiser, v. Szily, Scheerer, Tron) many of the established criteria of distinction between hypermetropia and myopia begin to fail. v. Szily, junr., especially has stressed the developmental origin of many of these so-called myopic changes, and regards myopia in such cases as the result of developmental defects in the posterior segment. Tron reports a case of myopia of 20·0 D. with typical myopic fundus changes (associated with choroidal coloboma), in an eye of only 22·39 mm. axial length.

The tendency to regard the lower degrees of myopia as physiological variations and the higher degrees as congenital or uncongenitally determined anomalies receives support from the views advanced by Vogt. Stressing the fact that the post-embryonic growth of the retina doubles its surface, Vogt holds that axial length accommodates itself to that growth; when the retina grows more rapidly than the sclera, the sclera becomes stretched, but the retina itself is not thinned in myopia, as can be shown by actual measurement (Vogt, Heine). Hereditary tendencies towards myopia or hypermetropia are explained by the hereditary tendency towards large or small retinae. The so-called myopic changes in the fundus Vogt regards as further hereditary-determined characteristics. They may be regarded as a sort of abiotrophic manifestation, and show considerable similarity to senile degeneration around

the disc and macula. It is well to recall in this connection that experimental embryology has shown the paramount influence of the retina on the growth of the surrounding structures. Thus a transplanted optic vesicle will convert the ectoderm of the abdominal wall with which it is placed in contact into a lens, and a damaged retina at the posterior pole will check the axial growth of the eye. That the eye itself is not influenced in its growth by external conditions has been shown in the case of the salamander by Stone, who interchanged larval eyes of two species. The transplanted eyes followed closely the growth curves of their donor controls, but this did not apply to limbs similarly interchanged.

Much as recent work has clarified the issue, it cannot be said that all established factors are covered by the more modern views. Certainly, the problem of myopia has not been solved, as some continental authorities seem to believe. One bed-rock fact which recent work seems to ignore in its stressing of the essential unity of all spherical errors is the vastly different behaviours of the hypermetropic and myopic eye during school-life. The hypermetropic eye is for all practical purposes a stationary eye; the myopic eye is essentially progressive during these years. It is true, as the writer has shown elsewhere, that a considerable percentage of hypermetropic eyes are progressive during school-life, and a surprisingly large percentage of myopes show but little progression. Such facts help to stress the unity of refractive errors, but do not demolish the essentially different behaviour of the two types of eyes. Besides, it may well be that the progressive hypermetropic eye and the stationary myopic eye are but the beginning and end stages of that progressive process seen in myopia. To construct curves on one side of which is the hypermetropic eye and on the other side the myopic seems very much like constructing a curve of two different components. A physiological myopia in the sense of Steiger and of Tron should show exactly the same clinical behaviour as hypermetropic eyes. Much clinical experience will have to be explained away before such a contention can be proved.

Besides, it cannot be sufficiently emphasized that myopia develops during school life, and particularly after the age when the growth of the eye is regarded as being completed—the age of 8 years. Most school myopia becomes manifest at about the age of 12 years. If the growth of the eye has ceased by then, why should there be in a certain proportion of children a re-adjustment of axial length, or of the position or strength of the refracting media? This can hardly be a physiological process if it affects only a small percentage of children. A mass of problems have been thrown up by the work of Steiger and his school. What, for instance, is the refraction curve at the age of 8 years, *i.e.*, at the completion of the growth of the eye, and before the onset of myopia introduces a new factor?

What part do the cornea and the other refractive media play in cases of actively developing myopia? We know that the cornea and lens may have normal values in myopia, but did they have the same value before the onset of myopia?

It is unlikely that we shall solve the problem of myopia without intensive study in its breeding ground—the schools. The past refractive history of the child recently become myopic is still an unexplored field. Study for over a period of years of unselected children in the infants' schools, with their inevitable and unknown quota of ultimate myopes, will amply repay the labour, for school myopia remains to the key to the problem.

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THE REFRACTION IN CASES OF CONGENITAL TORTICOLLIS ASSOCIATED WITH HEMIATROPHY OF THE FACE

BY

ARNOLD SORSBY AND MARCELLI SHAW

LONDON

AMONG the numberless theories on myopia, the view has been advanced that the myopic eye is the expression of the architecture of the orbit. Stilling and his followers held that low orbits were associated with myopia and high orbits with hypermetropia. The immense literature that grew up on this anthropometric view of myopia led to negative or at the least inconclusive results. Schmidt-Rimpler held strongly that the orbit accommodates itself to the eye. In anisometropia the orbits were found to be of the same measurement on both sides—a fact that certainly does not lend any

support to Stilling's views. An interesting—and as far as we know—unexplored contrast to the evidence from anisometropia is supplied by the state of refraction in congenital torticollis. Here the orbit on the affected side shares the under-development of the face.

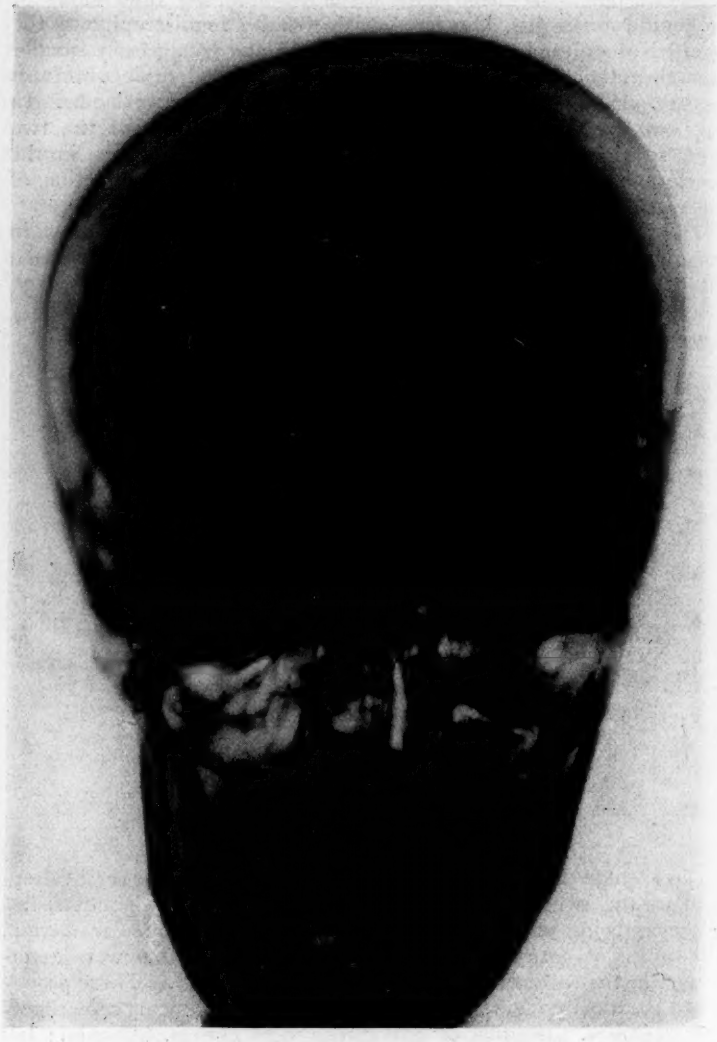
During the past five years we have observed nine cases of congenital torticollis associated with definite hemiatrophy of the face. Not only was the affected side of the face grossly smaller than the other, but the diameters of the affected orbit were also smaller. Five of the cases had had operations for the torticollis. In only one was there marked difference in the refraction of the two eyes, so that it is justifiable to conclude that influences in the development of the orbit do not affect the state of refraction of the eye.

The following summary table brings out the salient features in our nine cases:

Sex	Age	Whether operated for torticollis	Vision with correction		Refraction	
			R.	L.	R.	L.
M.	16	Yes	6/6	6/6	+1·5⊂+0·5↓	+2·0
F.	5	„			+1·5	+2·0
M.	12	„	6/6	6/9	+3·0	+2·0⊂+0·5→
M.	8	„	6/9	6/9	+3·5	+3·5
M.	53	—	6/6	6/5	+4·0⊂+0·5 120°	+2·5⊂+0·5 60°
M.	8	—	6/24	—	+3·5⊂+1·0 120°	+2·5⊂+1·0↓
F.	49	Yes	6/9	6/9	−1·25⊂−0·5↓	−0·5
M.	9	—	6/60	6/9	−6·0⊂−1·0→	+2·5
M.	12	—	6/6	6/6	+1·5	+1·25

To exclude the possibility of the comparatively equal total refraction of the two eyes being made up of unequal components, *i.e.*, the eyes being in reality asymmetrical in spite of equal refraction, the radius of corneal curvature and corneal refraction were determined in the seventh case in the series (F., aged 49). These proved to be practically identical in the two eyes, both showing remarkably low readings. (Radius of curvature: right cornea, 9·9 mm.; left cornea, 10·15 mm. Corneal refraction: right, 34 D.; left, 33·25 D.

The marked asymmetry of the skull and the markedly different shape of orbit is well shown by the accompanying reproduction of an X-ray taken from the same patient. In the original plate the



Case of Congenital Torticollis showing asymmetry of skull, including the orbits.

largest vertical diameter of the right orbit is 4·6 cm., that of the left 4·1 cm.; the largest horizontal diameters are 4·1 cm. and 3·9 cm. respectively.

We wish to express our indebtedness to the surgical staffs of the Royal Eye Hospital and of Guy's Hospital for permission to follow up cases under their care.

A DEVICE FOR PREVENTING GLARE IN ELECTRIC OPHTHALMOSCOPES

BY

N. BISHOP HARMAN

LONDON

THE introduction of the electric ophthalmoscope has greatly increased facilities for the examination of the interior of the eye, but the internal position of the source of the illumination within the instrument has produced certain new difficulties which the older reflecting ophthalmoscope did not possess. The electric lamp within the stem of the electric ophthalmoscope throws a beam of light parallel to the instrument, and this beam must be bent at right angles to enter the eye of the patient. Prisms and mirrors of various designs have been used to effect this bending. The desideratum is such a complete bending of the rays of light into the eye of the patient that the surgeon has a clear peep-hole through the instrument along the beam of light, and free from all disturbances such as will be caused by rays of light that may be diverted backward from the instrument so as to reach his own eye. If there are such aberrant rays the surgeon cannot see the fundus clearly by reason of the haze that is caused by the rays. The effect is somewhat similar to that disturbance to visibility produced by the rays of the head lamps of a car when there is a slight mist at night. These disturbing effects have become more evident with the increase in power of the light available.

The aberrant rays are brought about by several conditions. If a glass mirror with a drilled hole be used in the ophthalmoscope the beam of light will impinge upon the upper edge of this hole, and no matter how it may be blackened, this edge will scatter a blaze of disturbing light. If the mirror has no drilled hole but only a gap in the silvering, the hinder surface of the glass itself will reflect any light that may fall upon it from above the ophthalmoscope, and the slightest imperfection in the glass or dust upon it will increase the disturbance.

To overcome this defect, Marple cut out the upper edge of the mirror and used one of U shape. It was very successful, but the mirror was too fragile. A polished stainless steel mirror of U shape was substituted, but this has two drawbacks in that it has a lower reflecting power, and soon scratches, still further reducing the amount of light reflected. Prisms, such as were used in the first ophthalmoscopes, avoided some of the difficulties, but if they are well designed they are costly and permit very little variation of the beam, while the inexpensive ones are inefficient.

Recently, in discussing electric ophthalmoscopes with Mr. J. W. Tudor Thomas, of Cardiff, he told me that there had come into his possession an instrument, the origin of which he did not know, which

Section through mirror fitted with glare shield.

was free from these defects. A small tube had been fitted into the drilled hole of the glass mirror. This device is the simplest, most natural, and effective correction of the one difficulty of the electric ophthalmoscope. It does exactly what we instinctively do to protect our eyes from the glare. We shield them with our hands, or with hat-brims, or we fit vizors to the wind screens of our cars.

A small thin-walled tube is mounted within the hole of the mirror of the ophthalmoscope, the forward end of the tube is cut at an angle so that there projects from the hole of the mirror a crescentic ledge or shield. This shield fits the lower edge of the drilled hole, and projects just sufficiently to cast a shadow over the hole. When the shield is in position, no aberrant rays can be diverted into the surgeon's eye, and he gets a perfectly clear view into the patient's eye. For a mirror set at an angle of 45° to the beam from the lamp, and a hole of 2 mm. diameter, the shield fitted to the lower edge of the hole must project 2·5 mm. to provide complete protection. The shield is made of metal, and is fitted to the metal bed-plate of the mirror, but is independent of the mirror glass, so

that it is secure and not likely to be broken. Also the mirror glass can be detached without disturbing the metal shield.

One small difficulty arose in the use of the device. When the beam from the lamp was exactly centred in the mirror, it was found that the shield cut out the focused rays when they met at the position of the shield. This difficulty was overcome by slightly decentering the lamp, so that the beam when exactly focused on the mirror impinged upon it to one side of the drilled hole. This decentering has no drawback. Messrs. Rayner, of New Bond Street, have fitted this shield to the new electric ophthalmoscope made by them for me, and which was described in your issue of February, 1932. The device is a real advantage, and it will be the standard pattern. It has been fitted to other instruments and has effected a great improvement in each case.

ANNOTATION

Fishy Vision

An interesting article, under the above heading, is contributed to the *Fishing Gazette* of February 20, 1932, by M. S. Mayou, who is a keen fisherman as well as an ophthalmic surgeon, and is thereby doubly qualified to write on this subject. His paper is an admirable exposition which is addressed principally to those fishermen who have no special knowledge of how sight is conducted, but it will not fail to interest the ophthalmic surgeon also. Fish do not have to rely on visual impressions entirely, as cutaneous sensations tell them their position in the stream, the strength of the current and the presence of obstacles such as weed and stones. The cutaneous nerve endings link up with ganglia along the lateral line on either side of the fish, and with a highly developed auditory system.

In investigating the visual powers of fresh-water fish three lines of approach may be used: first, observations on what a fish appears to see; second, the anatomical structure of the fish's eye, optic tracts and brain as compared with those of mammals; and thirdly, the experimentally placing one's own eye under water and estimating from what one sees how much a fish can see. The third method is wholly unreliable, as the eyes and brain of a fish are not constructed as in the human.

Mayou has experimented with perch in a tank. He found that when bits of worm were dropped into the tank without a splash between the fish and the daylight, they were secured by the fish every time; if, on the other hand, the bit was dropped between the

fish and a tall bush which shadowed the other side of the tank, it as often as not fell to the bottom without being secured. There was no stream in the tank, and the perch mostly lay with their heads facing the light and their tails to the dark side. It would appear that it is the object coming between the fish and the light which enables the fish to see things rapidly.

Towards the end of last year he examined a number of fresh-water fish with a luminous retinoscope, and found that fish out of water, as is usually described, are myopic, but when the eyes are covered with water they are either emmetropic or hypermetropic. He points out also that the light and movement senses are very acute in fish, but that their form sense is poor.

The fish's field is a panoramic one. Fishermen know that "the size and dressing, heavy or light to resemble the natural animal is far more important than the colour." With regard to colour vision fish live for the most part in monochromatic surroundings. Mayou considers it unlikely that the trout has colour vision, though it has a good discrimination of shades. He points out that a human being with good colour vision cannot tell the colour details of a fly situated between the eyes and the sky overhead.

Mayou's excellent article should do much to refute popular errors with regard to the vision of fishes, and in a piscatorial annotation we may not inaptly quote the remarks of Sir Thomas Browne on Lampreys in the third book of his *Pseudodoxia;* that great disperser of errors.

"Whether Lampries have nine eyes, as is received, we durst refer it unto *Polyphemus*, who had but one, to judge it. An error concerning eyes, occasioned by the error of eyes; deduced from the appearance of diverse cavities or holes on either side, which some call eyes that carelessly behold them; and is not only refutable by experience, but also repugnant unto Reason. For beside the monstrosity they fasten unto Nature, in contriving many eyes, who hath made but two unto any Animal, that is, one of each side, according to the division of the brain; it were a superfluous inartificial act to place and settle so many in one plane; for the two extreams would sufficiently perform the office of sight without the help of the intermediate eyes, and behold as much as all seven joyned together. For the visible base of the object would be defined by these two; and the middle eyes, although they behold the same thing, yet could they not behold so much thereof as these; so were it no advantage unto man to have a third eye between those two he hath already; and the fiction of Argus seems more reasonable than this; for though he had many eyes, yet were they placed in circumference and positions of advantage, and so are they placed in several lines in Spiders."

ABSTRACTS

I.—GLAUCOMA

(1) **Haden, Henry C. Houston (Texas).—Some observations in regard to glaucoma simplex.** *Arch. of Ophthal.*, September, 1930.

(1) For the last few years, **Haden** has been measuring the intra-ocular pressure of all his patients except young children, and those with certain inflammatory conditions. The original type of Schiötz tonometer was used and some 5,000 measurements were made. These showed that increase in intra-ocular pressure can exist for a long time without any of the classical signs or symptoms of glaucoma, but that eventually these signs will appear unless remedial measures are used to bring the pressure within normal limits. The average pressure was in the region of 18 mm. Hg, *i.e.*, well below the upper physiological limit of 25 mm. Hg given by Schiötz. There was no practical difference in the intra-ocular pressure at various ages, nor did the pressure vary with the size of the cornea, the eye or the pupil, the size and shape of the physiological cup, the state of the refraction or the blood pressure. The author concludes that routine tonometric measurement is the most reliable method of making an early diagnosis of glaucoma.

F. A. W.-N.

(2) **Rosengren, B. (Lund, Sweden).—Studies on the depth of the anterior chamber with special reference to primary glaucoma. (Studien ueber die Tiefe der vordern Augenkammer mit besonderer Hinsicht auf ihr Verhalten beim primären Glaukom).** *Acta Ophthal.*, Vol. VIII, pp. 99-136, 1930. Vol. IX, pp. 103-179, 1931.

(2) **Rosengren** undertook careful and extensive measurements of the depth of the anterior chamber by means of Lindstedt's apparatus in order to determine the variations with age of the depth of the anterior chamber when accommodation is relaxed, and to find whether any light is thrown on the pathogenesis of glaucoma by a study of the difference in depth of the chamber in the two eyes of an individual.

From an examination of several hundreds of cases he concludes that

(1) The depth of the anterior chamber shows very marked variations with different individuals and with advancing age.

(2) The very marked individual variations show a symmetrical

variation curve, closely corresponding to a theoretically derived curve.

(3) The diminution of the depth with age is a progressive process, though the rate of diminution is low in the more advanced years. At the age of 25, the average depth of the chamber is 3·60 mm.; at 70 it has declined to 3·15 mm.

(4) The depth of the chamber in the two eyes of the same individual is for all practical purposes, alike.

(5) On the average the anterior chamber is shallower in glaucoma than in the normal eye; but not all cases of glaucoma show a shallow chamber. The lower average is due to the fact that a group of cases of glaucoma show an exceptionally shallow chamber.

(6) The shallow chamber in glaucoma is not the result of the increased tension for it is observable in eyes before they have become glaucomatous.

(7) A shallow chamber is a predisposing cause of glaucoma.

(8) Those eyes which have shallow chambers and develop glaucoma, generally go through an acute attack, though some cases only develop glaucoma simplex.

ARNOLD SORSBY.

(3) **Jahnke, W. (Berlin).—Histological findings in a case of glaucoma associated with facial naevus. (Histologischer Befund bei Glaukom und gleichseitigem Naevus flammeus faciei).** *Zeitschr. f. Augenheilk.*, Vol. LXXIV, p. 165, 1931.

(3) **Jahnke** reports the case of a man aged 43 years, with left-sided facial naevus and absolute glaucoma of the left eye. The eye had been noted as blind at the age of 11 years, but may have been blind from birth. X-ray examination revealed a very tortuous network of diploë veins on the same side as the facial naevus and glaucoma. Excision of the eye was unassociated with abnormal orbital haemorrhage, and microscopic section revealed a haemangioma of the choroid. Congenital abnormalities in the filtration angle were not seen. The literature on the subject is reviewed.

ARNOLD SORSBY.

(4) **Weekers, L. (Liège).—The mode of action of surgical treatment in glaucoma. (L'action hypotonisante, chirugicale et médicamenteuse dans la thérapeutique antiglaucomateuse).** *Acta Ophthal.*, Vol. VIII, p. 253, 1930.

(4) **Weekers** sees in glaucoma a disturbance in the balance which normally exists between the production and elimination of aqueous. This balance may be maintained at different levels of intra-ocular pressure, for a change in one factor is accommodated by

a corresponding change in the other. Thus increased blood volume in the uvea causes a more vigorous circulation, and hence a more vigorous elimination of aqueous. He holds that the success of the large variety of operations for glaucoma is due not to the reasons generally assigned for the different operations, but the common factor they all possess in being traumatic injuries to the eye. Experimentally all kinds of injuries produce lowered tension, the mechanism being some obscure change in the circulation of the eye —a view for which some experimental evidence is quoted from earlier work by the author. Glaucoma operations act, therefore, owing to their traumatic nature. The ideal glaucoma operation is that which inflicts the mildest possible injury and permanently lowers tension. Iris-inclusion probably satisfies these requirements best, at least in chronic glaucoma.

ARNOLD SORSBY.

(5) **Weekers, L. and Hubin, R. (Liège)—Results of the iris-inclusion operation in glaucoma. (Résultats obtenus par l'enclavement de l'Iris, dans le Glaucome).** *Arch. d'Ophtal.*, March, 1931.

(5) This paper, based upon the experience of the writers in a series of 50 cases, contains material which will prove helpful to those who employ, or who desire to employ the operation of iris-inclusion in the treatment of glaucoma. **Weekers** and **Hubin** are advocates of this operation and express the opinion that "the advantages of iris-inclusion are, on the one hand, that it is easy of execution, and on the other, that it is well tolerated by the eye. While of great efficacy it is much less mutilating than other anti-glaucoma operations."

The technique advised (and illustrated) differs from that originally described by Holth, in that a conjunctival flap is dissected from the sclera by scissors, and that the scleral incision is made (tangentially to the limbus above) by cutting movements with a cataract knife, over a length of 6 to 7 mm. If the iris does not protrude through the incision it is withdrawn by forceps, and is occasionally, but not invariably, divided meridionally. The flap is secured by two or three stitches. Holth believed that the operation was suitable only in cases of chronic glaucoma: the writers have employed it in acute, chronic and secondary forms.

The results obtained by Weekers and Hubin are given in terms of intra-ocular pressure, not in those of visual acuity.

In three tables, of acute, chronic and secondary glaucoma, numbering in all 43 cases, the tonometric measurements before and after operation are set forth. The interval between the operation and the subsequent estimation of tension varied from one to twenty-three months. These figures should be studied by those interested;

but it may be recorded that in the acute and chronic cases the results were very satisfactory; in the secondary forms, as might be expected, less so.

In the opinion of the writers iris-inclusion is the most efficient operation for reducing to a sufficient degree the tension of a highly glaucomatous eyeball. In primary glaucoma a condition of hypotony commonly results; this they believe does not constitute a danger to the future wellbeing of the eye.

J. B. LAWFORD.

II.—GENERAL MEDICINE

(1) **Jaensch, P. A. (Breslau).—Bilateral paresis of superior oblique as the one disturbance of motility in Pineal gland tumour. (Doppelseitige Trochlearisparese als einzige Motilitätsstörung bei Zirbeldrüssentumor).** *Zeitschr. f. Augenheilk.*, Vol. LXXV, p. 58, 1931.

(1) **Jaensch** reports a case of papilloedema in which the only other ocular lesion was paresis of both superior obliques. Details of the nature of the diplopia are described, and the progress of the case given in full. The nature of the underlying intracranial lesion could not be determined, in spite of extensive investigation and exploration, until the post-mortem examination showed it to be a tumour of the pineal gland. The diagnostic significance of the bilateral paresis is discussed.

ARNOLD SORSBY.

(2) **Guist, G. (Vienna).—Arterial hypertension and the eye. (Arterielle Hypertension und Auge).** *Zeitschr. f. Augenheilk.*, Vol. LXXIII, p. 232, 1931.

(2) From physical experiments and microscopic sections **Guist** shows the existence of two types of vascular changes in the retina in cases of hyperpiesis, falling in line with the classification of hypertension into primary and toxic varieties. In the primary variety the blood vessels are healthy; in the toxic both veins and arteries are affected.

The essential feature in primary hyperpiesis is to be sought in cork-screw tortuosity of the smaller veins, for in the absence of any changes in the vessel walls they are the first to distend under the increased pressure, owing to their having the thinnest walls. It is only later that the larger veins also become distended and tortuous.

Narrowing of the arteries is a much later sign, and the formation of white stripes along them, later still. Arterio-venous compression is relatively early.

In toxic hyperpiesis the arteries are thin from the beginning. Owing to structural changes in the vessel wall white stripes are present early. The smaller arterioles are only visible with difficulty, and owing to the thickening of the walls of the veins, the tortuosity is not so marked as in the case of primary hypertension. White stripes along the arteries and marked arterio-venous compression are the most significant features in toxic hyperpiesis.

ARNOLD SORSBY.

III.—THERAPEUTICS

Gérard, Professor Georges (Lille).— Ophthalmological Notes. No. 1. The appearance of severe specific complications in the course of treatment by intravenous injections of neo-salvarsan. (Notes de pratique ophtalmologique. 1. Eclosion d'accidents spécifiques graves en cours de traitement par intraveineuses de néosalvarsan). *La Clin. Ophtal.*, May, 1928.

The reviewer is uncertain to what extent he is able to reproduce the spirit of **Gérard's** communication and equally uncertain whether the author's views represent those of British syphilographers. Gérard's style of writing is rather difficult: it may perhaps be described as elliptical, dramatic and withal somewhat humorous. If he is here correctly interpreted, he is profoundly mistrustful of the newer methods of treating syphilis. These methods may be successful, or on the other hand, may lead to the reawakening of the disease. He pins his faith to mercury and iodide and some account of his views and methods may be of interest, mainly in his own words.

"Iodide of potassium is for me" and for the older authors such as Fournier "one of the *royal* methods of treating syphilis in general and ocular syphilis in particular. Iodism exists, nevertheless, appearing sometimes not only as a troublesome complication which may lead to abandonment of the drug but as an event capable of causing serious accidents and of threatening life itself. How and why do these accidents occur? In what class of subjects do they appear?" (To these questions the answer is partly given in No. 4 of the following statements.) "(1) I obtain success where others do not and that without changing the drugs which have been ordered. (2) Iodide, to be efficacious, must be

prescribed for a long time in considerable doses. (3) Iodide of potassium acts upon syphilitics whose general health is good. (4) It poisons doubly diseased (doublement tarés) syphilitics and especially those who are tuberculous or pretuberculous. . . ." While ocular syphilis is to be regarded as a tertiary manifestation, nevertheless Gérard commences with five or six intramuscular injections of grey oil. At the same time he prescribes a solution of potassium iodide, 1 gramme in 15 grammes of distilled water, to be taken as follows (with due regard to sex, weight and general condition) by adults: "First day, one dessert spoonful (for a female) to one tablespoonful. Second day, two spoonsful. Third day, three spoonsful and so on up to 8 or 10 for a female and 12 or even 15 for a male. Increase up to 8 or 15 spoonsful in 8 or 15 days, increasing by one spoonful per day. Then decrease from 8 or 15 (as the case may be) to one spoonful, a reduction of one per day. Stop treatment for eight days and then begin again." (NOTE.—The dosage which seems to allow of either dessert or soup spoons strikes one as rather elastic.—*Reviewer.*)

In giving this prescription to the patient Gérard also puts matters plainly to the patient, thus:—"If we are to get a cure I am obliged to apply very strong measures (*traitement de cheval*). This treatment must be founded on the doses of iodide given in my prescription. (The patient is also warned against a possible expression of surprise on the part of the chemist.) In all probability you will begin by disliking the iodide very much. You will curse me: with cold in the head, catarrh, cough, pimples all over you, headaches and so on. But don't let all this annoy you. After three or four days you will be all right. Then you will have some pains in the stomach, for the most part not very bad, and a little diarrhoea. If these symptoms are really very troublesome stop using the medicine for one or two days and begin again with the dose at which you left off. Have the bottle refilled as soon as it is empty." Gérard holds that small doses are often badly tolerated and lead to iodism lasting eight days or more. He has a few straight words to say about proprietory preparations which contain doses of iodide incapable of doing any good, for a disease which it is necessary to strike "good and hard" (*vite et fort*). He also points out that it is advisable to warn the patient that iodide is an expensive drug, and mentions incidentally that forty grammes of iodide will cost thirty francs. Finally (except for a passing reference to iodism in the tuberculous) Gérard says:—"I do not despise either arsenic or bismuth, but I retain all my affection for good old mercury, lusty grey oil, and for cyanide so dear to ophthalmologists, no less than for strong solution of iodide . . . . which one must prescribe in doses capable of giving a real result and a true success."

ERNEST THOMSON.

IV.—DEVELOPMENT

Culler, A. M. and Walls, G. L. (Ann Arbor, Michigan)—Ectopic cone nuclei. *Arch. of Ophthal.*, Vol. III, p. 736, June, 1930.

Culler and **Walls** found some ectopic cone nuclei in the histological examination of a clinically normal eye of a man aged 61 years. They were most numerous in the paracentral portion of the fundus, none being seen nearer to the centre of the fovea than 320 microns. The vast majority of the nuclei were wholly outside the external limiting membrane in massive peripheral cones and exhibited a striking differentiation. All but one or two of those within 1·25 mm. of the fovea possessed a clear vacuole in their distal ends, which vacuole was absent in all the ectopic nuclei further than this distance from the fovea. The author is doubtful as to the significance of the differentiation, but suggests that it indicates a "difference in density of the interbacillar fluid in and outside of the macular region." It is interesting that although ectopic cone nuclei are not rare, ectopic nuclei have never been found in association with the rods. This is because the latter are too slender, and have their nuclei too far from the membrane to allow of one passing outside it during the processes of development, whereas with the cones, if the formation of the external limiting membrane is delayed, many nuclei might, by the time it forms, have been carried beyond the "margo," so that subsequent contraction of the membrane around each cone would squeeze such a nucleus and force it wholly above or below the outer limiting membrane. The distribution of the ectopic nuclei is explained as follows. The cones at the posterior pole are the earliest to differentiate, so that if the development of the external limiting membrane were delayed, it is just these cones which might have ectopic nuclei. Differentiation of the foveal cones, however, occurs later so that even if the differentiation of the external limiting membrane were delayed, the cones would not be sufficiently large for the nuclei to become ectopic. It is significant that in the lamprey, where the limiting membrane is very thin, ectopic cone nuclei are of common occurrence.

F. A. W-N.

V.—ANATOMY

(1) **Bartels, M. (Dortmund).—Are there special nerve-fibres for the consensual pupil reaction? (Gibt es besondere Pupillenfassern für die indirekte Reaktion?)** *Zeitschr. f. Augenheilk.*, Vol. LXXV, p. 22, 1931.

(1) **Bartels** had a case of severe retrobulbar neuritis, in which at its height vision was completely gone (No P.L.). Direct pupil

reaction was absent, but consensual reaction present. After recovery, leaving vision of 5/50, the direct reaction did not return. Bartels argues that there are distinct fibres subserving pupil reactions to light, and that these are divided into two sets, one for direct, the other for consensual reaction. He sees no evidence for direct irritability of iris musculature to light.

ARNOLD SORSBY.

(2) **Gualdi, Vincenzo (Parma).—Variations of the anatomy and physiology of the palpebral lacrymal gland. (Ricerche sulla Posizione, sulla forma e sulle Dimensioni della Ghiandola Lacrimale Palpebrale Nell'Occhio Sano e Ammalato anche in Rapporto colla sua Funzione Fisiologica.** *Boll. d'Ocul.*, May, 1931.

(2) **Gualdi** noted a year ago, the case of a young man who could voluntarily produce a flow of tears; he noted that the lacrymal gland there was unusually large, and he has made a series of observations with the view of deciding the limits of variation of the gland. With this aim he examined the eyes of 466 subjects; some were attending the clinic for disease of the eyes, some were normal. Seeing that it was not possible to measure the size of the gland directly with calipers, Gualdi made models, in paraffin wax, of the various glands as they presented themselves and attaching these to a rod, he had the means of comparing the gland of a new case with those already seen. When a new size presented itself, the model was made and attached to the series. From these measurements he established the index of size and development, dividing the product of the length and breadth of the visible gland by the thickness. (It would seem to give a better idea of the total size of the gland to multiply the three factors together.) The mean dimensions were length, 4·82 mm., breadth, 3·46 mm., and thickness 2·44 mm.

He finds that the gland is generally enlarged in acute conjunctivitis and in trachoma. The gland is larger, also, in males than in females.

HAROLD GRIMSDALE.

VI.—PATHOLOGY AND BACTERIOLOGY

(1) **Scalinci (Naples).—Anti-virus therapy in ocular infections. L'Antivirudterapia nelle Infezioni Oculari).** *Boll. d'Ocul.*, March, 1931.

(1) The problem of producing local immunity is of special interest to ophthalmic surgeons, who have of necessity to work in a field which is seldom, if ever sterile. Besredka's views on local

immunity have stimulated many researches, and have added to our knowledge thereby. He regards immunity, both active and passive, as due to a substance formed by the inter-reaction of the micro-organisms and the cells which are sensitive to them. To this substance he has given the name of the anti-virus.

He holds that this body acts on these cells, and makes them to some extent less sensitive to the micro-organisms.

In all cases it is better to use an antivirus made from the micro-organisms which are causing the disease, cultivated from the patient himself; but in many diseases of the eye, it is not possible to wait while this is being done, and therefore it is often necessary to use a polyvalent antivirus which may be kept in stock.

In chronic conditions such as blepharitis, an auto-antivirus is much more effective than any other remedy; it may be used as an ointment rubbed into the edge of the lids. In chronic dacryo-cystitis, also, the antivirus, in solution is stated to have excellent results.

HAROLD GRIMSDALE.

(2) **Woods, Alan C. (Baltimore).—Chemical and immunologic researches on lens protein.** *Arch. of Ophthal.*, July, 1930.

(2) **Woods** gives, in this article, an interesting survey of the work done up to date on the lens proteins. The lens contains an auto-oxidation system which depends on the reversible action whereby two molecules of cystein (a sulphur containing amino acid), can be converted by oxidation into one molecule of cystine with loss of a molecule of water. There are two definite factors in this system (I) a dialysable constituent known as glutathione and (II) a thermostable constituent later indentified as *beta* cristallin. This auto-oxidation system is sensitive to changes in the hydrogen-ion concentration and ceases to function at pH. 7, but in all probability this is not a factor in the production of senile cataract, since the lens tends to become more alkaline with advancing age. It was shown in 1907 that ultra violet light would coagulate protein, but Burge in 1909 found that 30 hours exposure to these rays produced no coagulation in lens protein. If however an excess of electrolytes, notably calcium and silicon were present, cataract was produced. Burge also found that the calcium content of a normal lens was 0·08 per cent., whereas in a cataractous lens it is increased to 15 per cent. He therefore believed that an excess of calcium and the absorption of ultra-violet light were the factors responsible for production of cataract. Later work has shown that this probably occurs by destruction of glutathione.

Infra-red rays are thought to act by producing deleterious effects on the iris and ciliary processes, thus affecting the quality of the

aqueous, and the nutrition of the lens. The lens protein would appear to comprise three substances, *alpha* and *beta* cristallin which are pseudo-globulins, and *gamma* cristallin which is an albumin. Though the lens protein is said to be species specific and not organ specific, yet with the exception of one observation by Roemer and Gebb, there has been no demonstration of immunological changes in the organism, produced by lens protein in cases of senile cataract.

F. A. W-N.

VII.—UVEA

Jeandelize and Bretagne (Nancy).—Detection of the earliest evidence of sympathetic ophthalmitis by biomicroscopy. The practical results of early diagnosis. (Les premiers stades de l'Ophtalmie sympathique décelés par la Biomicroscopie. Conséquences pratiques du Diagnostic précoce). *Arch. d'Ophtal.*, February, 1930.

The two cases which form the basis of this communication are reported as examples of the value of biomicroscopy in the detection of the earliest manifestations of sympathetic ophthalmitis, or other ocular disease with like features. Vogt, in his Atlas, has drawn attention to the points stressed by **Jeandelize** and **Bretagne**.

Full clinical notes of the cases are given: in brief they refer to two examples of sympathetic disease, one following a perforating wound by a knife, the other a sclerecto-iridectomy for chronic glaucoma. In each case the occurrence of minute deposits on the posterior surface of the cornea, and in one of them minute flocculent deposits on the pigmented border of the iris, which were quite undiscoverable by the ordinary methods of examination, were revealed by the corneal microscope, and this when the eye showed not the slightest congestion. In one case vision was normal and no complaint had been made by the patient; in the other, vision had fallen owing to choroido-retinal changes, though the anterior segment of the globe appeared unaffected.

As a result of their experience the authors enunciate the following conclusions:

1. Cases of benign and fugitive sympathetic ophthalmitis occur which cannot be detected by ordinary methods of examination. At the present time only by the aid of biomicroscopy can their existence be determined. Hence it is advisable that careful biomicroscopic examination should be made in every case of penetrating wound whether accidental or operative. It is an error to think that sympathetic

ophthalmitis can be ruled out because no sign of it can be detected on investigation by ordinary means, no matter how thoroughly this is carried out, or because there is no complaint by the patient. The slit-lamp may reveal a very slight sympathetic reaction, even after a perfectly performed aseptic operation.

2. It is certainly correct to consider the so called "sympathetic irritation," the manifestations of which are chiefly functional, a modality of sympathetic ophthalmitis; it is, in reality, a more decided manifestation than the fugitive variety in which there may be a complete absence of subjective symptoms.

3. These "latent" forms of sympathetic ophthalmitis deserve to be searched for and treated with the same care as the more usual and classical form of the disease.

J. B. LAWFORD.

VIII.—PTOSIS

Bardelli, Professor Lorenzo (Firenze).—A new operation for ptosis. (Di una nuova operazione per la ptosi palpebrale). *Boll. d'Ocul.*, April, 1929.

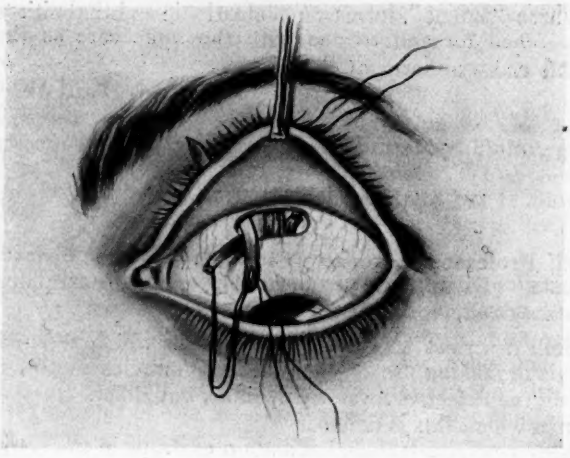
Bardelli describes an operation for ptosis which resembles that of Motais in making use of the elevating muscles of the globe to substitute the defective levator palpebrae, but differs from it in the manner in which this is done.

He uses local anaesthesia, instillation of drops in the conjunctival sac, subconjunctival injection for 2 cm. along the course of the superior rectus muscle, and also along the upper edge of the tarsus, and subcutaneous injection at the points, 5 mm. from the free border of the lid, at which the special needle described later will emerge.

Description of the Operation.—The upper lid is everted and the upper edge of the tarsus is transfixed by a sharp hook by means of which the upper lid is pulled strongly upwards and the upper fornix well exposed. Another sharp hook, or a stitch, transfixes conjunctiva and episcleral tissue immediately above the limbus and draws the eye down. The superior rectus muscle is exposed by an incision which is made obliquely to give better exposure. The incision in the conjunctiva is a free one and extends well into the upper fornix. The muscle is raised on a squint hook and its edges are freed for 12 mm. from its insertion.

The next step is the separation of a strip 3 mm. wide from one or both sides of the muscle. If the muscle is a strong one (11 mm. broad) a strip is separated from each side; if the muscle seems not

sufficiently strong, only from the outer side. To do this, a curved suture needle, armed with a silk thread, is taken and made to transfix the muscle near its insertion and 3 mm. from its edge. The needle is not at once passed completely through, but its sharp edge is used to separate the muscle fibres backwards for 1 cm. from the insertion. At this point the needle is brought through, and the muscle strip is ligatured I mm. from the highest point separated, the ends of the silk thread being left long. The muscle strip is divided just above the ligature and is turned forwards and freed to



its insertion into the sclerotic, the insertion being carefully preserved. It will now be seen how the operation now described differs from that of Motais. In that operation the muscle strip is divided from its insertion and is used to give a direct muscular pull on the upper lid. In Bardelli's operation the strip is divided from the muscle and left attached to its insertion, being used as a sling to connect the lid to the eye.

If a strip is to be taken also from the inner side of the muscle this is now done.

For the next stage of the operation Bardelli uses a special needle. This is a large curved needle, 3·5 mm. wide and 4·5 mm. long, the curve having a radius of 13 mm. It has a spear point and a very large eye. The thread on the outer muscle strip is passed through the eye of this special needle. The sharp hook is removed from the tarsus, and the lid is kept everted instead by fixation forceps which hold it by the lower margin. The special curved needle is inserted in the conjunctival wound, passed over the upper edge of

the tarsus, and then down between tarsus and orbicularis muscle to a point 5 mm. from the lid margin, where it perforates orbicularis and skin. In severe ptosis the needle may be brought out closer to the free margin of the lid. Gentle traction on the ligature draws the muscle strip out through the skin wound. The second strip is dealt with similarly.

Before fixing the muscle to the skin, the conjunctival wound is sutured. This Bardelli does in two halves, the bulbar and fornical conjunctiva being closed by separate running sutures which are not knotted. The lower ends fall on either side of the cornea, and the stitches are easily removed on the third day by pulling the free ends.

The muscle strips are fixed to the skin by silk mattress sutures, and before inserting them the strip is drawn down and the skin pushed up until the required effect is produced. Lastly a ligature is tied around the piece of muscle protruding from the skin wound, to prevent the muscle pulling free in the next day or two.

Dressing.—Bardelli draws the lower lid up to meet the upper and applies ambrine (surgical wax) and cotton.

The writer has used this method of operating for ptosis, using a needle sent to him by Professor Bardelli, and has found it simple and efficient. One has, indeed, to be careful not to produce an excessive raising of the lid. The wax dressing has not been used; a wire cage covered with gauze which is kept moistened, and instillation of castor oil, have sufficed to prevent drying of the cornea.

ARTHUR D. GRIFFITH.

IX.—MISCELLANEOUS

(1) **Rehsteiner, Karl (Zürich).—The first anatomical examination of a case of Leber's disease. (Die erste anatomische Untersuchung von geschlechtsgebunden-hereditärer Sehnervenatrophie).** *Arch. f. Ophthal.*, Vol. CXXV, p. 15.

(1) The case of hereditary optic atrophy, here reported by **Rehsteiner**, came to histological examination seven years after the onset of the disease.

In the eyeballs the only changes found were advanced atrophy of the nerve fibre layer and the ganglion-cell layer of the retina.

In cross sections of the optic nerve some portions were markedly atrophic and contained few or no medullary sheaths, while in other parts the nerve fibres were normal.

In the atrophic portions there was a moderate increase of the glia fibres together with a marked atrophy of the finer connective tissue septa.

The atrophied portion of the nerve occupied the temporal side

anteriorly, but, farther back, mainly the centre, thus corresponding to the situation of the papillomacular bundle (though greater in extent than it.)

There were no signs of inflammation, but it might be argued that in this, obviously late phase of the disease all evidence of the original inflammatory infiltration might have disappeared. The fact, however, that the appearances of the septa in this case bear a close resemblance to the late stages of toxic degenerations of the optic nerve (*e.g.*, in atoxyl poisoning) which are accepted as primary, and are in marked contrast to those of the septa in post-neuritic atrophy (where they are thickened), leads the author to the conclusion that even in the early stages of this disease inflammation was absent, and that Leber's disease is an inherited primary degeneration of parts of the retina and optic nerve.

The similarity of the histological changes in this affection to those of toxic degenerations of the optic nerve, above mentioned, affords no proof that it is due to a toxin from some endocrine disturbance, as has been suggested.

THOS. SNOWBALL.

(2) **Souter, W. Clark (Aberdeen).—Dr. William Harvey and Aberdeen.** *Aberdeen University Review*, November, 1931.

(2) Whole hearted congratulations will be accorded to Dr. Souter, not only by the ophthalmic fraternity, but also by many others among the profession and the laity for a first-class piece of antiquarian research on the connexion of William Harvey with Aberdeen. This interesting brochure is enriched by illustrations of the portrait of Harvey in the possession of the Aberdeen Medico-Chirurgical Society, the Houbraken print, taken from the portrait in Richard Mead's collection; and a photo of the page in the Burgess Roll of the City of Aberdeen, which records the entry under date of August 30, 1641. In passing a word of praise is due to those in custody of the city archives for the excellent way in which the records have been made and preserved.

Dr. Souter's interest in Harvey and his connexion with Aberdeen dates from nearly 20 years ago, and anyone at all familiar with historical research will appreciate the amount of patient labour that has been devoted to this pamphlet.

Sir D'Arcy Power, in his life of Harvey in *The Masters of Medicine Series*, only records one notice of Harvey in the year 1641, and so this research of Dr. Souter's helps to fill a blank in the life of our greatest English physiologist.

Harvey was admitted a free burgess of Aberdeen in company with Adrian Metcalfe, the Royal apothecary, and Alexander Midletun, sub-principal of King's College, Aberdeen. As Charles the First spent some months in Scotland in the autumn of the year in

question, the presence of his physician and apothecary is readily explicable.

Dr. Souter inclines to the view that Harvey was in Aberdeen at this date on university business probably, as this was the year of the union of two colleges to form the Caroline University. The Royal assent to the union was given at Holyrood on November 8, 1641. The union was confirmed by the Protector in 1654, and appears to have been in force for 20 years.

The reviewer, having been brought up on the works of Sir Walter Scott, has naturally wondered whether these newly admitted burgesses happened to meet the worthy Dugald Dalgetty, of Drumthwacket, alumnus of the Marischal College, at the dinner which was held to celebrate the proceedings, but has regretfully come to the conclusion that Dalgetty must have been abroad at the time.

R. R. J.

(3) **Birch-Hirschfeld, A. (Königsberg). — On the origin of traumatic enophthalmos. (Zur Genese des traumatischen Enophthalmos).** *Zeitschr. f. Augenheilk.*, Vol. LXXII, p. 259, 1930.

(3) **Birch-Hirschfeld** refers to his survey of the literature on the subject of traumatic enophthalmos, published in the volume on the orbit in the Graefe-Saemish Handbuch. The condition is rare, but not so rare as is suggested by the fact that there are published records of only 164 cases; it is frequently overlooked, for being generally associated with injuries to the orbit, it is overshadowed by the other signs of trauma. The trauma is usually of a severe kind; in 26 of the reported cases, it was caused by a kick from a hoof; but though fracture of the orbit, especially of the floor, is present in most cases, there are well-authenticated cases where this association was not present. Enophthalmos may appear immediately after the accident, or be delayed for days or weeks. Regression to the normal has been observed. The sinking backwards of the globe is generally not more than 2 mm.; but 6, 13 and 20 mm. have been recorded. In a few cases, changes in the pupillary reactions have been observed.

Birch-Hirschfeld reviews the possible causes. He finds no support for the suggestion that the enophthalmos is due to a tearing off of the trochlea. Diminution of the amount of orbital fat has been found in some cases; but the normal amount of fat has been present in at least one case. Injury to the sympathetic is discounted by the absence of other signs pointing in this direction. More can be said for enlargement of the orbital cavity, caused by fracture or by excavation of the walls; such conditions are almost always found; but the author has seen a case where the orbital cavity was enlarged

in the treatment of malignant disease, without in the least affecting the position of the globe. Scarring of the retrobulbar tissue may account for some cases, as rupture of the check ligaments does for others—and both these conditions may be the consequence of an injury which also involves fracture of the orbital walls. Injury to the fifth nerve, and presence of a foreign body in the orbit, ploughing up its tissues, are also discussed.

ARNOLD SORSBY.

BOOK NOTICES

Transactions of the Ophthalmological Society of the United Kingdom. Vol. LI, pp. 667. London: J. & A. Churhill. 1932.

The editors are to be congratulated on the punctual appearance of the 51st volume of *Transactions*, which contains the papers read before the Congress in London, in April, 1931, and those of the affiliated societies.

We hope to notice the more important of these contributions in abstract form in our later numbers.

The society is in a flourishing condition, with 553 ordinary and nine honorary members. Sir George Berry and Sir Arthur Keith have been elected honorary members of the society.

In spite of the heavy expenses incurred by the Jubilee Celebrations, the financial position is sound. This reflects great credit upon the treasurer, Sir Arnold Lawson, and his able coadjutor, Mr. C. J. Anderson.

The volume compares favourably with any and all of its 50 predecessors, and maintains the high standard set by the *Transactions* of this society.

Annual Report for the Ophthalmic Section, 1930, Department of Public Health, Egypt. Cairo: Government Press. Price, Ten Piastres.

There are now 46 ophthalmic clinics carried on by the Government of Egypt. Of these, 22 are specially built hospitals, 14 are travelling hospitals, and 10 are ophthalmic departments of general hospitals. This information is not stated clearly in the report, but is obtainable by analysing Table XXII.

More than half a million new patients were seen during the year, the average number of attendances being about seven, although as one sixth of the new patients attend on only one occasion, the average number of attendances for treatment is considerably more for each patient than as stated above. An innovation during the last few years, is that there are two weekly holidays instead of one. It is presumed that these are on Fridays and Sundays, and are designed

to afford leisure for religious observances, and incidentally more time for private practice to both Moslem and Coptic oculists, who as Government servants carry on the clinical and administrative work of the hospitals. It is difficult to believe that two whole day holidays a week for the hospital staffs conduce to the well-being of the patients.

The statistics, both of the work carried out at the hospitals, and at the ophthalmic clinics at the Government Schools, continue to be recorded with a wealth of detail unsurpassed in any other past or present publication. It is of very great importance to continue the annual publication of these statistics, in spite of the considerable expenditure of time and money which they must involve. The cost of the uniform dietary for the in-patients of the 1,000 beds in the various hospitals, works out at an average of sevenpence halfpenny per day. This includes a pound and a quarter of bread, and four ounces of meat, besides vegetables, lentils, rice, milk, butter and sugar. Members of finance committees of London hospitals would be glad if they could satisfy the appetites of the patients in the wards at such a moderate cost.

Operations for primary glaucoma were very numerous, more than a thousand iridectomies and the same number of corneo-scleral trephine operations having been performed. However, trichiasis and entropion resulting from trachoma accounted for the majority of operations, 73,290 in number.

The number of patients who were found to be blind in one or both eyes was 45,534, or 8·4 per cent. of all patients examined at the hospitals. By omitting the factor of blindness resulting from cataract, the percentage becomes 8, instead of 8·4. As there is a possibility that such cataract cases may acquire serviceable vision if a successful operation is performed, it is proposed in future reports to omit them when enumerating the number of blind people. However, at the actual time of examination, such patients are blind for statistical purposes, that is to say they cannot count fingers held up before them at a distance of one metre. The change is proposed under a misapprehension. The author has confused the statistical standard with the standard for signing up cataract cases in England as blind for purposes of pension. It is to be hoped that no change will be made in the data for the next report, as too favourable a position will be shown in comparison with the statistics which have been kept on a uniform standard for the last 22 years.

The pathological causes of blindness are given for 48,286 cases. It is shown that acute ophthalmias account for 80 per cent. of all causes. The gonococcus is still the dominant factor of infection with acute ophthalmias, its percentage to all other microbes being 44.

The report deserves careful consideration by all who are interested in ocular statistics and in causes of blindness.

CORRESPONDENCE

CERTIFICATION OF BLINDNESS AND ASCERTAINMENT OF THE CAUSES OF BLINDNESS

To the Editors of THE BRITISH JOURNAL OF OPHTHALMOLOGY.

SIRS,—The laudatory annotation upon the recent Report of the Prevention of Blindness Committee of the Union of Councils' Association for the Blind, which appears in the February issue of the Journal, scarcely does justice to the labours of a group of ophthalmic surgeons in Scotland who provided the material on which the greater part of the approved Report is based.

On page 109 due acknowledgment is made of the pioneer work of Dr. Freeland Fergus in Glasgow, but your annotation does not reveal that the Report of the Prevention of Blindness Committee of the Union of Councils' Association for the Blind is based, not upon the Report of the Council of Ophthalmologists, which appeared in the August number of the Journal (see pages 470-1), but upon important precedent work done in Scotland.

In 1922, a clinic was set up by the Mission to the Outdoor Blind for Glasgow and the south-west of Scotland, organized by Dr. Freeland Fergus. This clinic was taken over in 1929 by the Combination of Local Authorities under the Blind Persons Act (1920), for Glasgow and the south-west of Scotland area. It then came under the supervision of the Medical Officer of Health, Glasgow, its immediate direction being entrusted to Dr. James L. Halliday, of the Glasgow Public Health Staff. The success of this clinic led the Department of Health for Scotland in November, 1930, to recommend the establishment of regional clinics throughout the rest of Scotland, based on the Glasgow model, and centred in Edinburgh, Dundee, Aberdeen and Inverness. These clinics were soon set up and are all now functioning.

In March, 1931, the Department of Health for Scotland, having observed some divergence of interpretation of the standard of blindness by different certified surgeons, called a meeting of all the ophthalmic surgeons attached to the clinics, and asked them to try and lay down more precisely the factors to be taken into account in determining whether a person was, or was not, " so blind as to be unable to perform any work for which eyesight is essential," that being the definition employed in the Blind Persons Act of 1920, and applying both to England and Scotland.

At this first general meeting a sub-committee was appointed to consider the matter further and to prepare a preliminary Report. The sub-committee met on several occasions, and the draft prepared by them was discussed at another general meeting of all the

surgeons. With only slight modifications their recommendations were adopted by the Department, and on November 5, 1931, they were issued to the local Authorities in Scotland by the Department of Health and the Scottish Education Department in a joint memorandum. This has been the basis of certification in Scotland since that date.

The English Prevention of Blindness Committee already referred to were informed of the Scottish proposals, and their recommendations are based on, and are almost word for word, identical with ours. But anyone reading the Report issued from 66, Victoria Street, London, might naturally suppose that the standard of blindness now recommended throughout the country originated with the English Committee, but that is not the case.

I am sure I may say that my Scottish colleagues are gratified to see that their interpretation of a standard of blindness and their form of medical certificate have been so well received in England, because it would be highly undesirable to have any divergence of practice in the two countries. But it appears to me only fair and historically accurate that the names of the Scottish surgeons who did the spade work in connection with this advance in public administration should be given not less acknowledgment than those who acted on the English Committee.

The standard of blindness upon which statistics have hitherto been based varies in different countries, and this has made comparative statistics difficult or misleading. Uniformity should be aimed at.

The international Society for the Prevention of Blindness founded in 1929, have not so far tackled this problem of defining blindness. In this matter, as well as in the system of certification and provision for the blind, Great Britain may truly be said to have given a lead to the rest of the world.

The following gentlemen composed the General Committee in Scotland. An asterisk marks the names of those who served on the Sub-committee.

*Dr. Marshall *Dr. Walker Dr. Macmillan *Dr. Halliday Dr. Smith	Glasgow.	Dr. Allister MacGillivray Dr. Moodie Dr. Scott	Dundee.
		Dr. Galloway Dr. Souter	Aberdeen.
*Dr. MacKay *Dr. Graham *Dr. J. R. Paterson Dr. Ligertwood	Edinburgh.	Dr. Chalmers	Inverness.

Yours faithfully,

GEORGE MACKAY, M.D., F.R.C.S.E.,
Convener of the Sub-Committee.

BLINDNESS IN INDIA

To the Editors of THE BRITISH JOURNAL OF OPHTHALMOLOGY.

SIRS,—Some months ago I read in your issue of April, 1931, an account of the Second Annual Meeting of The International Association for the Prevention of Blindness. I was particularly interested in that portion of the account which referred to blindness in India, as I thought it misrepresented the opinions of some of the leading ophthalmologists in that country. I waited till my return to India in November last before making any written statement in this connection, as it was desirable to get into personal contact with certain Government officials interested in this subject. The information conveyed to the meeting with regard to blindness in India appears to have been in the form of an address by the late Mr. C. G. Henderson, I.C.S. (retired). He is reported in your columns to have conveyed the impression that blindness in India "according to more detailed enquiry" was something like three times the amount that the official census returns give and must total quite a million and a half, much of which can be prevented.

It would ill become me to belittle the work of the late Mr. C. G. Henderson, or the association of which he was president. Although I never quite saw eye to eye with its methods of work or publications, it always had my sympathy as a practical philanthropy. To those interested, our different points of view were indicated in an editorial in the Indian Medical Gazette for September, 1929, which discussed preventable blindness in India and the part played by the Blind Relief Association of Bombay. Since that time this body has assumed the title of the All-India Blind Relief Association and it was as President of that Association that Mr. Henderson spoke at Brussels. The title of the association gives the impression of an extensive organisation spread throughout the peninsula and as such entitled to express authoritative views on the subject to which it devotes itself. Actually the All-India Blind Relief Association is a small organisation with a very limited field of activity practically confined to a portion of the Bombay Presidency and Sind, in fact, to the sphere of action of the Bombay Blind Relief Association, which was its parent body.

Presumably the "more detailed enquiry" quoted above refers to investigations made by the President or members of this organisation. How they were made, or from what data it is inferred that the methods employed were more accurate than the official census return, is not obvious. Mr. M. W. W. M. Yeatts, I.C.S., the Special Census Officer for the Madras Presidency, with its population of 47,193,602, which, as in the case of other huge masses of

the general population in India is untouched by the All-India Blind Relief Association, assures me that the census figures in India are about as accurate as any in the world, and that Mr. Henderson, who had no experience of census operations, could not possibly have obtained more accurate information than is collected by the whole machinery of Government devoted to this work. I am also informed by an Indian civil servant, an ex-member of the Bombay Secretariat, that he cannot imagine any method by which an enquiry could possibly be carried out by a member of his service in more detail than by the Special Census Officer.

The late Mr. C. G. Henderson, I.C.S., was in fact an enthusiastic philanthropist with a great interest in the relief of blindness; he probably made detailed local observations, and presumably used these particular observations to form an opinion on a huge generalized problem, a very fallacious form of reasoning. For a great many reasons, there is a tendency to exaggerate the amount of blindness in India. I do not in any way wish to minimize the importance of this problem of blindness in India, or deny the possibility of a greater relative frequency in India, but when dealing with a subject of this kind, it is important to retain perspective. By reason of religious, climatic, and other conditions, the blind are more present with us in India, than, for example, in Europe, so that one easily gets a false impression. The impression becomes even more erroneous if one confines one's observations to isolated groups, such as the selected population of an eye infirmary or relief centre. The census operation overcomes this great fallacy, and gets as near mathematical accuracy with regard to total blindness as any private individual, or even a small association, is likely to get.

With regard to the different causes of blindness, the census returns can furnish very valuable basic figures which help us to judge of the relative importance of certain causes of blindness. Here again we must be careful not to judge by appearances or argue on analogy. I have in earlier years fallen into the error of presuming that because ophthalmia neonatorum was held to be the chief cause of preventable blindness in England and America, it was of similar importance in India. I now have a different opinion, and would like to take advantage in this letter, of restating it. I believe that keratomalacia is the chief cause of preventable blindness in India. In your report on the Meeting of the International Association for the Prevention of Blindness, referred to above, page 248, I see that Dr. Lossonaru attributes "35 per cent. of the blindness in China to small pox." Further we read "xerosis from faulty hygiene ranks next, although it must be presumed that this is a temporary cause only." Why presume that it is a temporary cause? There is nothing to suggest a temporary nature in the total loss of the cornea and lens which is a common sight in

our out-patients' department. In an article in the *Lancet* for April 11, 1931, which has probably passed unnoticed by the International Association for the Prevention of Blindness, I tried to show that keratomalacia (not ophthalmia neonatorum) was the greatest cause of preventable blindness in India. I referred to the difficulty of dealing with such a huge economic problem. This note of pessimism has become even more justified in the last months. Still I am convinced that a great deal of good might be done by well directed efforts to combat preventable blindness. The prevention of blindness is a problem to which any philanthropic organisation, carefully advised and controlled, might well direct its attention, but in so far as blind relief goes, the Government ophthalmic organisations in this country are in a better position to extend such relief than any philanthropic body. Public money, which is given with a view to the relief of blindness in India, would be much more economically administered by the existing machinery, and thus save the cost of reduplicating administrative staff.

Yours faithfully,

ROBERT E. WRIGHT,
C.I.E., Lt.-Col., I.M.S.

MADRAS.

NOTES

Appointment

DR. LÖHLEIN, of Jena, has been appointed Professor of Ophthalmology at Freiburg i. B., in succession to Theodor Axenfeld.

* * * *

Royal London Ophthalmic Hospital. Annual Dinner

THE Annual Dinner of past and present students of the Royal London Ophthalmic Hospital, Moorfields, took place at the Langham Hotel on Thursday, February 11, 1932.

Sir William Lister, K.C.M.G., was in the Chair, and among those present were General Sir Harold B. Fawcus, K.C.B.; Vice-Admiral St. G. S. Bond, C.B.; Sir Peter Chalmers Mitchell; Sir Arnold Lawson, K.B.E.; Mr. Theodore Luling (Chairman of the Hospital); Messrs. T. Harold Clouston, H. G. R. Vaisey, T. Wontner

Smith, Dr. Gordon Holmes, Mr. Treacher Collins, Mr. J. H. Fisher, Lady Lister, Miss Evelyn Richmond, Miss Agneta Strachan.

The Toast of the Hospital and Medical School was proposed by the Chairman and was responded to by Mr. Luling and Mr. Goulden, the Dean of the School.

The Dean submitted his Annual Report in which he said that although there has been a slight diminution in the number of students attending the Hospital they reached nevertheless 161, of of which 77 were new admissions. Among successes at examinations it was gratifying to know that of the 65 candidates who sat for the Diploma of Ophthalmic Medicine and Surgery of the Conjoint Board, of whom 38 were successful, Moorfields students accounted for 31. At the Diploma of Ophthalmology of the University of Oxford, of seven successful candidates five came from Moorfields. During the year also, three students had obtained the Diploma of F.R.C.S. of Edinburgh. Since 1926, 31 students have obtained the Edinburgh Fellowship.

The proposed improvements, enlargement of the Out-Patients' department and Medical School, which had been proposed two years ago were likely to be put in hand, although last Autumn this seemed unlikely. The result of the changes will be a larger and more conveniently worked Out-Patients' department, greater facilities for teaching and much larger Medical School buildings.

* * * *

Annual Report, 1931, St. Margaret's Hospital, by M. S. Mayou

AS will be seen by the table below the number of cases of ophthalmia neonatorum notified in London has not diminished during the last sixteen years. There was a considerable increase after the War, with a corresponding increase of patients seeking admission to St. Margaret's Hospital. The number of admissions of recent years has become a fairly constant factor. The most striking point in the statistics is the amount of blindness, which has decreased by more than half as St. Margaret's Hospital has become known and utilized.

There are at present 218 children under 18 years of age on the roll of the L.C.C. blind schools; of these, 45, a percentage of 20·6, are blind from ophthalmia neonatorum. Although this is an enormous improvement on old statistics of blind institutions, it is probably still unduly high. I believe that further improvement is possible by the proper teaching and training of midwives and medical students. At the present time midwives receive a far better education on the subject than the medical student. Classes are given at St. Margaret's to midwives from Queen Charlotte's Hospital, the L.C.C., and other bodies. The medical student receives no education on the subject and probably has never seen

a case during his training, although the law requires him when qualified to notify the disease.*

LONDON COUNTY COUNCIL.

Year.	Notification of ophthalmia neonatorum for London.	Numbers admitted to St. Margaret's Hospital.	Children discharged blind in both eyes from St. Margaret's Hospital.	Blindness due to ophthalmia neonatorum.	
				Year of Birth.	Children admitted to L.C.C. blind schools.
1915	700	—	—	1915	6
1916	773	—	—	1916	5
1917	641	—	—	1917	5
1918	613	58 (from Sept.)	—	1918	4
1919	870	281	4	1919	6
1920	1,186	252	4	1920	5
1921	1,076	213	4	1921	6†
1922	867	213	0	1922	3
1923	761	225	0	1923	2
1924	724	179	1	1924	1
1925	705	186	—	1925	2†
1926	705	198	0	1926	
1927	812	211	0		
1928	733	204	0		
1929	728	224	1		
1930	617	196	1		
1931	628	215	—		

* For further details of treatment, etc., see *British Medical Journal*, November 28, 1931.

† Including one doubtful case.

* * * *

St. Margaret's Hospital for Ophthalmia Neonatorum

THE annual returns for St. Margaret's Hospital for Ophthalmia Neonatorum for the years 1930 and 1931 are as follows:—

No. of children admitted		No. of children discharged with both eyes blind		No. of children discharged with single eye blind		No. of eyes with impaired vision	
1930	1931	1930	1931	1930	1931	1930	1931
196	215	1	—	2	1	(7 single eye, —both eyes)	(10 single eye, 3 both eyes)

DEATHS—BABIES 9.

Septicaemia	1
Gastritis and Prematurity (2)	3
Necrosis of jaw	1
Meningocele—Prematurity	1
Congenital Syphilis—Prematurity	3
Total	9

* * * *

White Oak Hospital, Swanley, Kent

REPORT by M. S. Mayou, F.R.C.S., visiting ophthalmic surgeon, on the treatment of eye diseases at White Oak, Swanley, Kent.

The following are the returns from White Oak Hospital:—

Disease.	*Number of Admissions.*	*Number of Discharges.*
Mucopurulent Ophthalmia	22	15
Conjunctivitis (Chronic)	11	28
Keratitis	4	7
Corneal Ulcer...	5	10
Phlyctenular Conjunctivitis and Phlyctenular Keratitis	61	73
Chronic Blepharitis and Conjunctivitis	98	102
Interstitial Keratitis	21	29
Follicular Conjunctivitis	7	9
Trachoma	21	56
Spring Catarrh	—	2
Total	250	331
Remaining at commencement of year		285
Admitted direct		250
Re-admitted from hospitals		30
Total		280
Discharged cured		284
Demanded by parents		47
Transferred temporarily to other hospitals ...		28
Total		359
Remaining at end of year, 1931		206

During the year artificial sunlight was given 5,982 times, and in addition to this natural sunlight was used in the summer time when possible.

The treatment of chronic blepharitis with vaccine has been continued. For the result of such treatment see *Trans. Ophthal. Soc. U.K.*, Vol. LI., 1931, p. 48.

* * * *

Corrigendum

DR. DOUGLAS GAWLER, of Perth, West Australia, has drawn our attention to a misprint on p. 8, in Mr. Treacher Collins's article on the Physiology of Weeping—"Kola" should read Koala.

FUTURE ARRANGEMENTS

1932

April 1.—Midland Ophthalmological Society, at Birmingham Eye Hospital.

April 8.—North of England Ophthalmological Society, at Sheffield.

May 12-14.—Annual Congress of the Ophthalmological Society of the United Kingdom, at Edinburgh.

June 7.—Midland Ophthalmological Society, at Gloucester Royal Infirmary.

June 10.—Section of Ophthalmology, Royal Society of Medicine. (Annual Meeting).

October 4.—Midland Ophthalmological Society, at Birmingham Eye Hospital.

CONTEMPORARY OPHTHALMIC LITERATURE

American Journal of Ophthalmology. *February, 1932.*

BEIGELMAN. Dystrophy of the corneal epithelium in vernal catarrh.
HARRISON. The Barraquer operation for the removal of senile cataract.
DVORAK-THEOBALD. Oculoglandular tularemia.
BARKAN, OTTO. A procedure for the extraction of congenital, soft and membranous cataracts.

COWAN. Concerning a membrane, between the vitreous and anterior chamber, seen after removal of the crystalline lens and its capsule.
HEATH. Measles encephalitis.
FEJER. The treatment of painful absolute glaucoma and other eye diseases with retrobulbar injections of alcohol.

Archives of Ophthalmology. *January, 1932.*

DE SCHWEINITZ. Blindness and papilloedema in Guernsey calves, usually bulls, including the results of post-mortem examination of two of the affected animals.
GIFFORD. The mild form of epithelial dystrophy of the cornea.
SAMUELS. Methods of formation of the posterior abscess in ulcus serpens.
LUEDDE. The mechanism of accommodation. Facts and fancies.
O'BRIEN. The cataract of post-operative tetany, with a report of three cases.
LAMB. Sympathetic ophthalmia from a nonperforating trauma. Report of a case.
STOKES. Unusual retinal vascular changes in traumatic injury of the chest: angiopathia retinae traumatica (Purtscher).
SELINGER. An operative procedure for pyramidal cataract.

Annales d'Oculistique. *January, 1932.*

KALT, E. and KALT, M. Latent infection of the lacrimal passages.
WEILL. Ectopia lentis and general malformations.
BERCIOUX. Concerning the technique of Lindner-Guist in Gonin's operation.

Archives d'Ophtalmologie. *February, 1932.*

WEEKERS and HUBIN. Spontaneous cure of detachment of the retina. What are the possibilities of functional recovery in a detached retina?
VILLARD, DEJEAN and TEMPLE. Three cases of embolism of the central artery of the retina. The part played by super-added arterial spasm.
VANCEA. The part played by the pancreas in the spontaneous resorption of cataract.
LONGCHAMPT and REBOUL. Four cases of Parinaud's conjunctivitis.
FRANÇOIS. A lymphomatous syphilide of the conjunctiva.
CASTERAN. Classes for amblyopes.

Revue d'Oto-Neuro-Ophtalmologie. *December, 1931.*

BOURGUIGNON. Chronaxie in epidemic encephalitis.
PAVIA. On two cases of hypophyseal tumour.
ANGLADE and LASSALLE. Histological appearances of the cerebral peduncle in sections taken at the level of emergence of the 3rd nerve in encephalitis with residual paralyses of the nerve.
VILLARD and ROGER. Relapsing bullous keratitis in a patient who had probably suffered ten years previously with serous meningitis of the posterior fossa.

Klinische Monatsblätter für Augenheilkunde. *February, 1932.*

PETERS. On the histology of trachoma.
WIEDERSHEIM. On the path of movement in miners' nystagmus.
KLOESS. On cord-like appearances in the vitreous.
DEUTSCHMANN. On inhalation treatment with amyl nitrite.
BIETTI. On the action of endogenous toxins on the eye.

MAY, On conservative treatment of pulsating exophthalmos.
SONDERMANN, R. and G. On corneal trephining in ulcus serpens and other eye diseases.
v. SZABÓ. On a case of innocent Fuchs' epithelioma of the ciliary body.
v. CSAPODY. On detachment of the retina (cured by cauterisation) and heredity.
v. ROSCIN. On the question of the origin of blister-like prominences in the ciliary epithelium.

Zeitschrift für Augenheilkunde. *February, 1932.*

JUNIUS. Amaurotic family idiocy.
LAUBER. On optically corrected safety glasses.
KESTENBAUM. On the topical diagnosis of hemianopia.
KRASSO. On lenticonus posterior.
PROCKSCH. On the treatment of acute dacryocystitis, and swelling of the lids with cocaine packs in the nose
v. CSAPODY-MOCSY. Handicraft and visual acuity.
KUNZ. The statistics of trachoma in East Prussia.

Archivio di Ottalmologia. *December, 1931.*

BALDANZELLU and TROVATI. On clinical reports of trachoma and tuberculosis.
CATTANEO. Raynaud's disease and cataract.

January, 1932.

ROSSI. Primary glaucoma and organic constitution (*cont.*).

Bollettino d'Oculistica. *January, 1932.*

ACCARDI and FONTANA. On the effect of *intra-vitam* staining on the intra-ocular tension, the pupillary diameter, the albumin content and the index of refraction of the aqueous.
GIANNANTONI. The influence of the actual form of the anterior surface of the lens on the refraction of the eye.
ZINGALE. On primary tuberculosis of the conjunctiva.
LUGLI. On chancre of the sebaceous glands of the palpebral fissure.
LODDONI. On a case of blue sclerotics.
PERGOLA. On the treatment of cicatricial corneal opacity.

Archivos de Oftalmología Hispano-Americanos. *February, 1932.*

TORRES. Purulent conjunctivitis of the newly born.
MENDOZA. Intra-capsular extraction of cataract according to Elschnig.
PIQUERO. Trachoma and constitution.